UNIVERSITY OF ALBERTA

Psychophysiological Aspects of Fibromyalgia

by

Jim Eliuk

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the
requirements for the degree of Doctor of Philosophy

Department of Educational Psychology

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled PSYCHOPHYSIOLOGICAL ASPECTS OF FIBROMYALGIA submitted by JIM ELIUK in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

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DEDICATION

The task of undertaking and completing a doctoral dissertation is one which involves several processes that can be complementary or conflicting. This project is the result of a combination of individual as well as group efforts. It has allowed me to develop and refine a knowledge base and body of skills which will guide me in my future work with people suffering from chronic pain complaints. It has also assisted me in questioning more critically not only the traditional ways we have of providing therapeutic services, but also of questioning the many non-traditional ways which are becoming available to the general public.

I would like to express my appreciation to my committee members for their guidance and support throughout this project: Dr. George Fitzsimmons, my supervisor and mentor; Drs. Peter Calder and Ronna Jevne of the Department of Educational Psychology; Dr. Anthony Russell of the Department of Rheumatology; and Dr. Jean Wessel of the Faculty of Rehabilitation Medicine. I would also like to extend my gratitude to the external reader, Dr. Gary Rollman of the Department of Psychology, University of Western Ontario for giving of his valuable time to provide critical comments on the project. I am also very appreciative of the technical assistance and suggestions provided by Roy Jaffray of CRAME, and by Drs. Kerri Pain and David Erickson of the Glenrose Rehabilitation Hospital. Special thanks must also be offered to Ms. Peggy Nesbitt who provided the human figure

renderings which were used to identify the tender points in the study group.

This project would not have been completed without the cooperation of the individuals suffering from Fibromyalgia as well as from those volunteers who made up the control group. Their willingness to give freely of their time is greatly appreciated.

Finally, the most appreciation must be reserved for my wife, Joan, and our children, Kendra and David. Not only did Joan assist with the typing and retyping of this finished product, but she also stood by me during the past six years of learning. Her patience through the different role changes I experienced as father, husband, student, and breadwinner is truly remarkable. While this struggle may not have been as evident to Kendra and David. I know that they also tolerated stress and for my contribution to this stress, I apologize. If there was an award equivalent to this graduate degree, Joan, Kendra, and David would surely have earned it.

ABSTRACT

The purpose of this project is to examine the role of electromyographic (EMG) biofeedback in the assessment and treatment of Fibromyalgia Syndrome (FMS). The project is presented in a paper format, with each paper examining a specific issue related to the broader question. Papers 1 and 2 investigate the problem by asking if dysponetic mechanisms are causative factors for FMS pain and if so, can EMG biofeedback correct the muscle dysfunction.

In Paper 1, bilateral surface EMG readings were collected from three muscle groups proximal to three FMS tender points. Readings from 25 FMS subjects were collected as each subject sat in a relaxed position, put each muscle to work, or performed an activity requiring them to lift two, 1 kg weights while standing. These readings were compared with readings obtained from 20 non-pain controls under the same conditions. There was no difference in magnitude of EMG signal between the two samples nor was there a between-group difference of right-left difference in each muscle group (i.e., right versus left brachioradialis muscle). Elevated readings and bilateral asymmetry are two mechanisms present when dysponesis or muscle bracing is occurring. The lack of differences between the two groups in these two features indicates that dysponetic mechanisms are not at the root of the pain experienced in FMS.

In Paper 2, five FMS subjects received 12 sessions of EMG biofeedback to determine if a slow return to baseline following a

dynamic protocol, another mechanism indicative of muscle bracing, was at the root of the FMS pain. There was insufficient evidence to support this mechanism as causing the pain these subjects experienced.

A comparison of life history issues obtained from FMS and non-pain subjects during a one-hour semi-structured interview was carried out in Paper 3. FMS subjects experienced more early childhood psychological trauma, work-related stress, medical illness, and described weaker social support systems than did the individauls in the non-pain sample.

Evidence from the three papers indicates that dysponetic muscle mechnanisms are not the cause for FMS pain but that there are many life history issues which differentiate FMS pain sufferers from non-pain subjects. The differences in life history variables warrants further investigation to determine what role if any is played by these variables in causing or maintaining FMS pain.

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CHAPTER 1

INTRODUCTION

This is a paper thesis reporting on three studies exploring the effects which a specific psychological assessment and treatment technique can have in the assessment and treatment of a chronic pain condition termed Fibrositis/Fibromyalgia (FMS). The three studies encompassing this project are aimed at furthering the knowledge base in understanding the mechanisms underlying the development and maintenance of chronic pain. Current thinking with FMS suggests that the pain associated with different illnesses, syndromes, or structural defects stems from a central processing source; that is, the pain signals are misinterpreted at a neurological level.

Given this belief, the primary means by which change can be brought about is through the use of psychotropic medications. However, treatment options which put control of therapeutic processes back into the hands of the patient or client can serve to short-circuit any of a variety of psychological concerns which oftentimes accompany chronic illnesses. These concerns frequently serve to exacerbate the pain beyond customary limits and the suffering which becomes evident can effectively detract from the initial concern which is the chronic pain. These three exploratory studies will examine the value of biofeedback as a therapeutic modality available to FMS sufferers. The three studies will examine assessment and treatment aspects as well as

life-history variables of the FMS sample. The theoretical model which is being examined through the first two studies is the theory of dysponesis which was put forth by George Whatmore and Daniel Kohli in their 1974 book entitled The Physiopathology and Treatment of Functional Disorders. In brief their theory postulates that dysponesis or muscle bracing can furnish a basis for the development of chronic pain (a) through the presence of excessive muscle activity, (b) through an asymmetry in body musculature, (c) through the development of co-contractions in muscle structure, and (d) if a muscle is slow to return to a resting baseline once the activity initiated by a muscle has been completed. Three of these mechanisms will be dependent measures in the first two papers.

In the first study three common muscle groups containing tender points will be assessed for signs of bilateral asymmetry, excessive or insufficient electromyographic (EMG) activity, or slow return to baseline. EMG activity will be recorded while the client is requested to perform a specific movement which relies on the muscle group being monitored. Readings from a group of FMS sufferers will be compared with those from a group of non-pain subjects.

In the second study, EMG biofeedback treatment will be provided to five subjects on a biweekly basis to assist them in alleviating pain by correcting any observed physical basis for the chronic pain they have been experiencing. Attempts will be made to examine both the overt as well as covert effects of such

interventions. Overt effects will be measured by use of a visual analogue scale (VAS) to measure pain intensity. Examination of electromyographic (EMG) activity in specific muscle groups will also be made to evaluate changes in this physiological variable. Finally objective information regarding lifestyle (e.g., return to work, increase in participation in social/extracurricular activities, increase in ability to perform household chores), and by subjective impressions of improvement from the clients and their partners will be collected to determine the effects of interventions made on lifestyle.

Finally in the third study an examination will take place of the information obtained from a one-hour guided history taking session to determine if the life experience of people suffering from FMS differs from that of individuals who do not suffer from a chronic pain illness.

From this series of exploratory studies, it is hoped that a better definition of the role of the psychologist in the assessment and treatment of this patient group will be achieved. Also, a better determination of the types of psychological treatment options which are suitable in treating this disorder will be provided.

This research project will first describe and discuss the medical syndrome labelled Fibromyalgia. A discussion of current etiological theories, psychological treatment regimens, and research shortfalls will be included. The review will end with a discussion of the role of psychological factors which are directly

or indirectly related to the clinical picture as well as to the role of psychological interventions in the treatment of FMS.

Next, I will discuss the methodology to be utilized during the course of the three studies. This will include information on the subject pool, assessment measures, and physiological measures which will be utilized; the manner in which the treatment protocol will be implemented; and on the type of data analysis to which the variables will be subjected.

This project will end with a brief discussion of how the findings will blend with existing knowledge of this condition. Some consideration of limitations of the project will also be offered.

The series of studies presented in this project represent the culmination of five years of study into the area of chronic pain. During that time, I have learned a great deal about how different individuals struggle to cope with ongoing and at times incapacitating pain. Some individuals cope with moderate degrees of success while others succumb to the debilitating process which chronic pain sets in motion. Regardless of the level of coping which takes place, there is no doubt that the lives of the people affected by this chronic state of pain are changed. While scientific knowledge about chronic pain and more particularly about Fibromyalgia has grown over the last 30 years there are still many controversial and disputed beliefs about the nature of the process involved

There are several questions which will be explored through the three studies. Study 1 will investigate if there is evidence of excessively elevated EMG readings when muscle activity from static and dynamic activities is examined in a group of people suffering from FMS and a group of people who do not suffer from any chronic pain. The first study will also explore if there is evidence of bilateral asymmetry in the muscles being examined. Study 2 will explore what happens to the muscles of FMS subjects after they are required to put the muscles being examined to work. Will there be a quick return to baseline? Finally, Study 3 will address the question of significant differences in the life experiences of people suffering from FMS as compared with people who do not suffer from chronic pain.

Glossary of Terms

The following definitions will be employed in an effort to clarify the terms used in this project.

Dysponesis in its simplest definition is a "form of misdirected effort" (Whatmore & Kohli, 1974, p. 68). It involves the signaling errors within an organism that, when large enough, can produce physiological changes "that impair the efficiency, productivity, or health of the organism" (p. 68).

Biofeedback has been defined by Basmajian (1983, p.1) as "the technique of using equipment (usually electronic) to reveal to human beings some of their physiological events, normal and abnormal, in the form of visual and auditory signals in order to

teach them to manipulate these otherwise involuntary or unfelt events by manipulating the displayed signals".

Surface EMG refers to the electromyographic or myoelectric signal of the striated muscle being examined. Signals are obtained from sensors placed on the skin over the belly of the muscle after standardized skin preparation has taken place.

Chronic pain is considered to be "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (International Association for the Study of Pain Subcommittee on Taxonomy, 1979, p.250) and lasting more than six months after healing of the tissue damage would have taken place.

Bilateral asymmetry refers to a difference of 20% or more in EMG readings obtained from bilateral muscle groups.

Static protocol refers to a situation where the subject is not required to exert any physical activity while EMG activity is being recorded from a specific muscle.

Dynamic protocol refers to a situation where the individual initiates a behavior which requires recruitment of muscle activity specific to the action in question.

CHAPTER 2

FIBROMYALGIA

The syndrome which is the focus of this study was initially identified at the beginning of the 20th century (Gowers, 1904). Ongoing research following on the heels of that initial report was hampered by poor definition of the client population. Many terms were suggested to describe the syndrome. Terms such as myofascial pain syndrome, myofibrositis, interstitial myofibrositis, and rheumatic pain modulation disorder are only a few of the terms which have been used to describe this syndrome over the years. Use of the terms Fibromyalgia syndrome and fibromyalgia are currently the predominant terms used (Rice, 1987). Although most recently, Yunus (1994) has coined the term dysfunctional spectrum syndrome to encompass a variety of illnesses such as FMS, Chronic Fatigue Syndrome, Migraine, Temporomandibular Pain, and PMS in which he hypothesizes a neuroendocrine immune dysfunction.

Current diagnostic criteria required for accurate classification of this syndrome include:

1. the presence of widespread pain of at least three months duration; and

2. pain in 11 of 18 specific point sites on digital palpation with a pressure of 4 kg (Wolfe, Smythe, & Yunus, 1990).

Current Knowledge on Fibromyalgia

Sleep Disruption

A predominant finding which was first uncovered by Moldofsky,

Scarisbrick, England, and Smythe (1975) and which has since been replicated (Schakel & Horne, 1987; Simms, Gunderman, Howard, & Goldenberg, 1988) involved the presence of alpha-wave intrusion into delta and other sleep stages. The inability of FMS patients to move into a level-IV, nonREM sleep stage supports the behavioral observation of a non-restorative sleep cycle which these patients describe. These clients either have fitful sleep patterns or patterns whereby they have no difficulty falling or staying asleep. However, they characteristically awaken feeling tired, fatigued, stiff, and sore (McCain & Scudds, 1988). While the alpha-intrusion is not thought to be the cause of FMS, it is thought to have an intermediary and contributing role to the change in brain metabolism of serotonin and immune functions (Moldofsky, 1989). The use of medications which assist in inhibition of serotonin reuptake has met with a moderate degree of success in several studies (Carette, McCain, Bell, & Fam, 1986; Moldofsky & Lue, 1980; Zitman, Linssen, Edelbroek, & Stijnen, 1990).

The issue of a non-restorative sleep cycle has led researchers to more closely examine the neurophysiological factors involved in FMS. Biochemical examination of cerebrospinal fluid has led to the discovery of a lower rate of turnover of several neurotransmitters, including serotonin (Russell, Vaeroy, Javors, & Nyberg, 1992). The implication of this line of thinking is that the defect responsible for FMS occurs at the central neuroregulatory level.

Muscle Stiffness

A second finding which has been described in this condition is the gelling phenomenon (McCain & Scudds, 1988). This phenomenon is characteristically seen in many rheumatological conditions and refers to the "prolonged and diffuse muscular aching and stiffness" (McCain & Scudds, 1988, p. 275) which these patients encounter on awakening. The stiffness can be alleviated with exercise and stretching. McCain, Bell, Mai, and Halliday (1988), in examining the effects of cardiovascular fitness training or simple flexibility exercises on a group of 42 patients with primary fibromyalgia found that such exercises had a beneficial effect. Improvements were noted in both physician and patient global assessment, in pain threshold scores, and in a moderate decrease in pain intensity.

It should be noted, however, that while the gelling phenomenon in fibrositic patients shows marked similarities when compared with rheumatoid arthritic patients, there is a major difference in the locus of the stiffness. With the latter group, inflammation and stiffness of joints predominates. With the former group deep muscle tissue seem to be the predominant locus of the pain and stiffness.

Tender Points

The concept of tender points in muscles is another characteristic feature which distinguishes FMS from other rheumatological diseases. Under moderate pressure during palpation, FMS patients experience extreme levels of pain and will

generally exhibit the "jump sign" (Smythe, 1979) whereby they quickly withdraw from the examiner's touch.

While the concept of tender points has received widespread agreement, there has been less consistency regarding explanation for the mechanisms underlying the tender points.

Smythe (1989) believes the tender points to reflect/conduct pain emanating from deep tissue sites which have no representation in the cerebral cortex. As such there is little representation in the person's body image for the locus of pain. The fact that there has been no evidence of histological changes and limited evidence of EMG abnormalities has led to the use of more molecular investigatory techniques. Isotope studies, electron microscopy, tissue biopsies, and biochemical studies have shown the presence of significant differences in tissue samples when compared with controls. Yunus, Kalyan-Raman, Kalyan-Raman, and Masi (1986) conducted muscle biopsies in 12 individuals with primary fibromyalgia syndrome. While there was no evidence of inflammation using light microscope examination, histochemical analysis showed evidence of some muscle fiber atrophy and of a "moth-eaten" appearance in some fibers. However, the significance of these findings is still not fully understood.

Theoretical Foundations

Theory of Dysponesis

Dysponesis is the term used by Whatmore and Kohli (1979) to describe a "physiopathologic state made up of errors in energy expenditure within the nervous system" (p. 380). The errors

result in the establishment of splinting or bracing patterns in body musculature. The authors suggest that the reactions constituting the dysponesis are learned responses and furthermore that such dysponesis can affect emotional reactivity (e.g., emotional inhibition or disinhibition), ideation (perception), autonomic function (e.g. visceral or vascular disturbances), and primary sensations (e.g., reflexes). The diagnosis of a dysponetic state is made on the basis of history, physical examination and if necessary, laboratory and psychological studies. The use of electromyography to measure dysponesis provides a tangible measure of the level of splinting or bracing present. Effective treatment in the form of retraining specific circuits in the nervous system can then be instituted.

Neuromuscular Signal Disruption

Electromyographic (EMG) studies with FMS patients have demonstrated mixed results. Jacobsen and Danneskiold-Samsoe (1989) found a significant positive correlation between increases in the number of tenderpoints and decreases in muscle function as measured by isokinetic muscle strength. Their results did not demonstrate any correlation between daily physical activity and muscle strength. Given that tender points can often be found in tendon insertions and in the skin alone, they suggest that FMS is not only a disorder of the muscles but also that pain modulation mechanisms play an important role.

Zidar, Backman, Bengtsson, and Henriksson (1990) examined 22 female FMS patients for the presence of muscle fiber degeneration

and to study central activation and relaxation skills in these subjects. Needle electrodes were used to obtain EMG readings from 20-23 different motor unit potentials (MUPs) from three muscle groups (biceps brachii, trapezius, and tibialis anterior). Surface electrode readings were obtained bilaterally from the CPS muscles, the right trapezius and the right tibialis anterior to investigate for the presence of muscle tension. All readings were obtained while the patients were relaxed in a sitting and a supine position as well as during an isometric exercise. Non-specific changes observed in the MUPs were felt to be of no diagnostic significance. The researchers, while acknowledging that their results do not support the belief of constant muscle tension in FMS, do say that there may be increased muscle tension in muscle groups other that those they assessed.

Svebak, Anjia and Karstad (1993) expanded on the Zidar, Backman, Bengtsson and Henriksson (1990) study by assessing the EMG signal from a passive muscle group and an active muscle group during a dynamic task (manipulation of a computer joy-stick during performance of a perceptual-motor video task). Results indicated there was no difference in muscle tension. However there was an indication of co-contraction in the FMS group in comparison with a matched group of healthy controls. Additionally there was a difference in the amount of effort exerted and the quality of performance elicited when the two groups were compared. The FMS subjects demonstrated a pattern of high effort and poor performance. Svebak, Anjia, and Karstad (1993) interpreted these

results to "support the assumption that fibromyalgia presents as an example of hypersensitization in the pain pathways that is in concert with recent formulations of the modulating processes in the pain pathways" (p. 129).

Stokes, Colter, Klestov, and Cooper (1993) investigated for the presence of fatigue mechanisms in FMS patients by obtaining integrated EMG signals (iEMG) from surface sensors while the patient "performed an isometric hold against gravity with the upper body (that above the anterior, superior iliac spines) unsupported in a horizontal and prone position" (p. 712). Signals from the right paraspinal muscles at the L_4 level were collected, analyzed and compared against data collected from a control group of healthy volunteers. They found no evidence of muscle fatigue and also ruled out any effects which motivation and drive may have played in relation to fatigue. They did acknowledge that recruitment of additional muscle groups to maintain the test position may have occurred. They concluded that the use of multichannel EMG assessment could assist in overcoming this problem.

While these studies suggest that a basis for the chronic pain present in FMS patients lies in pain modulation processes and afferent pathways, there has not been a consistent examination of bilateral muscle groups in either dynamic or static formats and there has not been a further examination of the co-contraction seen in the Svebak, Anjia and Karstad study. As well the muscle groups chosen for investigation has been variable and has not

necessarily corresponded to the muscle groups in which the tender points reside.

Psychological Therapy and FMS

While treatment of FMS has resided primarily with medical disciplines, recent research has focused on the possible benefits which psychological therapies might provide to FMS sufferers. In this context, FMS is seen as a chronic pain illness. The therapeutic measures which have been considered as having possible advantages to this group of people have included hypnosis, electromyographic (EMG) and thermal biofeedback, cognitive behavioral modification techniques, and psychotherapy. These efforts have been replete with design complications making it difficult to properly evaluate treatment effects. Given that this is a clinical population, ethical considerations frequently take precedence over research design considerations (Basmajian & Hatch, 1979). Ferraccioli et al. (1987) demonstrated that EMG biofeedback was able to produce significant improvements in FMS symptomatology, tender points and scores from a visual analogue scale (VAS). They utilized a double-blind design but had a low number of subjects in their treatment ("true EMG BF", n=6) and in their control ("false EMG BF", n=6) groups. They found a significant treatment effect for the "true EMG BF group" which continued to be evident at 6-month follow-up. Despite these positive results, they were left with the question of exactly how EMG BF works with FMS sufferers. Several important criticisms of this study were offered by Bradley (1989) who commented on the use

of EMG BF on the frontalis muscle in the study patients. There has been considerable controversy regarding the relationship between generalized relaxation effects and activity in the frontalis muscle (Burish, Hendrix, & Frost, 1981). Additionally he pointed out that the patients were not assigned randomly to the groups.

In responding to these criticisms, Ferraccioli et al. (1989) agreed that it is difficult to support a hypothesis relating muscle tension with psychological tension. They acknowledged that mediating variables may be involved. Regarding the criticism of no random assignment to groups, they pointed out that while subjects in the "false EMG BF " may have become aware that they were not receiving any type of treatment, none dropped out of the study.

Haanen et al. (1991) reported on the use of hypnotherapy in the treatment of refractory FMS. They compared this treatment against a physiotherapy treatment group. Using random allocation to each group, treatment was carried out over a 3-month period. The hypnotherapy script utilized ego strengthening phrases and suggestions to control muscle pain, improve sleep disturbance, and assist in general relaxation. They found that the hypnotherapy treatment was more successful than physiotherapy in eliminating patient complaints, in lessening fatigue on awakening, and in improving sleeping habits and muscle pain. Additionally they noted a decrease in the somatic and psychic discomfort of the

subjects in the hypnotherapy group. These improvements were maintained a a 3-month follow-up.

The use of cognitive-behavioral therapy (CBT) as a treatment modality for FMS sufferers has been examined in studies by Bradley (1989) and Nielson, Walker, and McCain (1992). Of the two studies, the former lays out a research design which its author feels could examine the usefulness of such an approach in treatment. The design stems from research which has examined the usefulness of CBT in treating patients with rheumatic diseases and back pain. Relying heavily on the work of Turk, Meichenbaum, and Genest (1983), Bradley points to the need to teach persons "to believe that they can successfully use new skills to reduce pain and disability" (Bradley, 1989, p. 133).

Neilsen et al. (1992) used a quasiexperimental design to determine the benefits, if any, of CBT with a group of FMS sufferers. Treatment was provided to thirty patients over the course of a three-week inpatient program that was multidisciplinary in nature. The participants were taught progressive muscle relaxation. They engaged in a daily routine of aerobic exercise and stretching. Activities of daily living were simulated so as to increase endurance and to teach the subjects to set realistic limits to their activity level and to withdraw from activities when they began to overdo it. As the research participants were drawn from an inpatient population, participants were also allowed to practice the skills they had learned during the second weekend of the treatment program when they were allowed

to return home. Each participant served as their own control as there was, on average a 5 month wait prior to hospital admission. Follow-up data was collected at the end of the three-week treatment program. Complete results were available on 25 patients.

In evaluating the successfulness of the treatment program, Neilsen et al. (1992) divided the outcome measures into target and nontarget variables. The former included pain severity, perceived interference of pain in their lives, the subject's sense of control over pain, and emotional distress. These variables were assessed using psychometric instruments. The nontarget variables which were not expected to change with treatment included perceived support by others, response by significant others to pain, marital adjustment, and activity level.

The results demonstrated that there were no changes in target or nontarget variables during the 5-month waiting period. Statistically significant differences were obtained however in all target variables when pretest and posttest scores were compared. The authors suggest viewing the results with caution pointing to the possibility of a type II error with regard to nontarget variables. Besides referring to the need for larger study samples, they also point to the need for a longer follow-up period to ensure that the treatment provided does in fact have lasting effects.

Research Shortfalls

There are several areas of concern in these research studies. First, controlling for the effect of medications, because of ethical considerations, is in many instances not possible. This invariably confounds the results. The variety of medications used (e.g., nonsteroidal antiinflammatory drugs, antidepressants, muscle relaxants, analgesics, tranquilizers) further confounds the picture.

The use of small numbers of subjects in clinical studies is a second major difficulty. The likelihood of a type II error is everpresent whenever this situation exists. Bradley (1989) suggests the use of a Bonferroni correction, use of multivariate analysis of variance, or use of factor analysis as statistical methods in situations where there are major problems arising from the number of subjects relative to the number of variables being analyzed.

A third complicating difficulty from an examination of the literature comes from the lack of standard protocols which serve to describe treatment provided by hypnosis, CBT, biofeedback or other psychological modalities. In the Haanen et al. (1991) study four interventions were included in the hypnotherapy script. Ferraccioli et al. (1987) utilized EMG BF of the frontalis muscle yet other studies evaluating the usefulness of EMG BF with different chronic pain groups focus on different muscle groups, use different protocols, or even use different biofeedback modalities (e.g., thermal, GSR).

A fourth difficulty comes from the wide variety of variables which are defined as outcome measures. Dependent variables have ranged from psychological variables (e.g., depression, anxiety, pain perception) to physiological variables (e.g., tender points, sleep disturbance). While a considerable amount has been written on psychiatric variables in relation to FMS the field would benefit from a definition of the important outcome variables to assess following any type of treatment regimen.

A fifth difficulty with much current research is that is in not based in a theoretical perspective, rather the focus is on determining if there are physiological changes which underlie the illness.

A final point which has not been examined rigorously is that dynamic EMG protocols might produce results different from static EMG protocols. Recent work (Donaldson, 1989) has demonstrated that use of dynamic procedures in EMG BF can provide valuable and different information regarding psychophysiological correlates of pain. Such information can be invaluable in directing treatment.

Study 1

In the first study two postulates from the theory of dysponesis were examined in a group of FMS patients. The first question investigated was whether there are differences in elevation of EMG readings between FMS patients and a group of non-pain control subjects matched for age, sex, and educational level. EMG readings were compared for three muscle groups containing or directly adjacent to tender points. Baseline EMG readings were

taken from all subjects. Following this a dynamic EMG protocol was utilized. This allowed for testing of a second feature of the theory of dysponesis, the issue of bilateral asymmetry. EMG activity was recorded from three sets of muscles: upper trapezius, brachioradialis, and lower sternocleidomastoid (SCM).

Sample

Patients were solicited on a voluntary basis from a Rheumatology department at a local teaching hospital, from a soft tissue pain clinic and from a monthly FMS support group in the community (see Appendix A). Participants in the study were informed of the study rational and consent forms were signed (see Appendix B) by all individuals interested in participating in the project. Control group members did not belong to any pain related diagnostic categories.

Twenty-five FMS subjects and 20 non-pain controls between 20-60 years were assessed in each group.

All subjects were administered the VAS at the beginning, middle, and at the end of the assessment session.

Three activities, specific to each muscle group being examined were performed by all subjects. To assess the SCM muscle the subject was asked to slowly turn their head to the left five times then to the right five times. This provided information on right and left SCM activity. To assess the EMG activity from the upper trapezius, the subjects were requested to slowly shrug both shoulders five times. To assess the EMG activity from the brachioradialis muscle, each subject was requested to rest each

arm in a sling then to flex their hand from their wrist five times.

A final piece of activity to assess the EMG activity from two muscles conjointly consisted of each subject being requested to take a 1 kg weight in each hand and to lift each weight perpendicular to their bodies at 90° five times during a 30 second time span while standing.

Data Analysis

Analysis of variance was used to assess the reliability of the VAS score across the three times during the assessment phase. Demographic variables (i.e., age and education) were compared using a t-test for independent samples. A t-test for equality of means was used to examine the differences in EMG readings across the muscle groups between the FMS and the non-pain group.

Study 2

Five subjects were selected from the FMS group for EMG biofeedback treatment. The five subjects from the FMS group were selected as follows. The mean reading plus two standard deviations for each muscle group of the non-pain control was calculated. Each FMS subject's EMG signal was then compared against these readings. Subjects chosen for treatment included two FMS subjects who had readings greater than 2 standard deviations above the mean at six or more of the condition muscle sites of the non-pain controls. Two FMS subjects had readings greater then 2 standard deviations at three of the sites. One FMS subject had no readings greater than 2 standard deviations from

the mean of any site. While there has been no evidence of FMS presenting with different degrees of severity, an attempt was made to choose five subjects who presented with differing degrees of muscle activity to determine if in fact this variable was an important one in treatment protocols.

Utilizing a single-subject research design, these five subjects were seen on a biweekly basis for 12 sessions. Each session was 45 minutes in length. Biofeedback was utilized as an educative tool to make subjects aware of the relationship between the EMG signal and posture, psychosocial stressors, and ergonomic factors. For example, if elevated EMG reading were obtained in Study 1, the subject would be taught methods designed to relax/decrease the muscle activity. VAS scores were elicited at the beginning and at the end of each treatment session.

Subjects were asked to complete a portion of the West Haven-Yale Multidimensional Pain Inventory (MPI) (Kerns, Turk, & Rudy, 1985) at the beginning and end of the treatment phase. Additionally, they were asked to have their spouse, adult child, or boyfriend complete the questionnaire at the same time.

Instruments

Integrated EMG (iEMG) signals were collected on an IBM compatible 386DX computer utilizing Unicomp Biofeedback software (American Biotec Corporation) with four channels using m-501 J & J modules for EMG signal collection. To minimize the amount of physical intrusion from attachment of the sensors, all sensors were attached to the three bilateral muscle sites prior to data

collection. Changes were made at the juncture of the electrode leads and the amplification unit as readings were collected from each muscle group so as to avoid unnecessary external influence on the EMG signal. Readings obtained represented the amplitude of the EMG signal.

Data Analysis

Data analysis involved an examination of the ability of each subject to return a specific muscle to a baseline level after being required to perform a task requiring the specific muscles being examined in the study. This information was derived from the last six sessions during which a dynamic activity was introduced. The first six sessions did not utilize a dynamic protocol. Any change in perceived pain intensity, and changes in activity level both inside and outside the home for each subject was also examined. An examination of the return to baseline of the mean EMG signal across treatment sessions is presented in graphical form. Changes in the VAS score of the five subjects across treatment sessions were also examined and compared with the VAS scores obtained in Study 1. Ability to return to household or work duties was examined utilizing a portion of the MPI.

Significance of the Findings to Current Knowledge

While the majority of research in FMS is pointing to causative factors residing in central pain modulating mechanisms, there continue to be findings which suggest that biofeedback and cognitive behavioral techniques may have benefits for this group of chronic pain sufferers. It is hoped that findings from Study 1

will help determine if there is any value in assessing the muscle groups associated with tender points in FMS clients. Should there be no significant difference between the EMG activity in the three muscle groups being assessed across the two groups, then EMG BF could effectively be ruled out as an assessment option. From a theoretical perspective, this would indicate that dysponetic mechanisms are not involved in initiating or maintaining the chronic pain observed in FMS sufferers.

The use of dynamic assessment and treatment protocols can also provide new information which can be relevant to assisting these clients. Again, the theory of dysponesis can furnish the backdrop against which the results become important. Lack of findings supporting the theory of dysponesis could be construed as providing support for the notion that the problem in pain modulation lies in the nerve signal, somewhere between the central origins and the muscle site at the periphery.

Finally, it is hoped that the results would assist in more clearly defining the role that psychologists could play in helping FMS clients overcome the physiological and emotional problems associated with their illness so as to enable them to once again become useful members of society.

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Running head: ELECTROMYOGRAPHIC ASSESSMENT

Electromyographic Assessment of Fibromyalgia

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ELECTROMYOGRAPHIC ASSESSMENT OF FIBROMYALGIA

Fibromyalgia (FMS) is a chronic pain illness in which people complain of musculoskeletal soreness throughout the body (Vitali et al. 1989; Zidar, Backman, Bengtsson, & Henriksson, 1990). Immunological abnormalities, psychopathological changes and mechanical stressors have been investigated as possibly playing a role in the etiology and maintenance of the chronic pain seen in FMS (Ahles, Yunus, Riley, Bradley, & Masi, 1984; Payne et al. 1982). However researchers have been unsuccessful in demonstrating the basis for the musculoskeletal pain. Because the pain is widespread and can include multiple tissues, including muscles, tendons, skin, and bones, the presence of an "aberrant central pain mechanism" (Yunus, 1993, p. 26; Lindh, Johansson, Hedberg, & Grimby, 1994) has been advanced as underlying the pain process.

The presence of a nonrestorative sleep pattern has also been documented (Moldofsky, 1989). The presence of alpha-wave intrusion in the sleep cycle prevents FMS sufferers from obtaining the required amount of Stage IV restorative sleep.

FMS affects women by a ratio of 6:1 over men. Reproducible tenderness to palpation at 18 specified tender points throughout the body has led to the concept of the FMS sufferer as "hurting all over" (Yunus, Masi, Calabro, Miller, & Feigenbaum, 1981). Additional research has focused on psychological features, physical trauma, neurosensory pathology, immunologic

abnormalities, hypoxia, muscle pathology, and neurotransmitter involvement (Russell, 1994).

As the diagnosis of FMS has gained credibility, and the body of knowledge about the illness has become broader, more disciplines have become involved in attempting to provide relief to the FMS sufferer. Therapeutic attempts have focused on fostering and supporting a return to as normal a lifestyle as can be achieved. Psychological/psychiatric interventions have focused on the depressive symptoms which generally accompany FMS. There remains considerable controversy regarding the relationship of FMS with depression. Yunus and Masi (1993) reviewed psychological studies examining the relationship between depression and FMS. They listed four reasons against the likelihood of a causal relationship between depression and FMS. First depression was no more common in FMS than in Rheumatoid Arthritis. Secondly, the dosage level of anti-depressant medication which is effective in FMS is subtherapeutic in depression. Third there is no correlation between cortisol nonsuppression and depression in FMS. Finally, platlet binding of ^{3}H-imipramine is increased in FMS but decreased in depression.

Research focussing on neuromuscular dysfunction as an etiological factor in FMS has met with mixed results. Initial attempts have examined a variety of muscle groups, several quite unrelated to the tender points, as well as muscle groups which are quite broad/large in nature. Vitali et al. (1989) examined a group of 49 randomly selected patients with FMS referred to a

Rheumatic Disease Unit for the presence of neuromuscular hyperexcitability (NMHE). While only 19 of the 49 patients had two or more signs indicative of NMHE, the number of signs seen were significantly higher in the FMS patients than in a control group of 33 rheumatoid arthritis (RA) patients. The most frequent sign, cramps, was evident in 63% of the FMS patients compared with 39% of the RA group ($p<.05$). The second most frequent sign, tremors, was observed in 41% of the FMS group compared with 6% in the RA group ($p<.005$). However, EMG activity was recorded only from the thenar prominence. Zidar et al. (1990) examined a group of 22 female FMS patients for the presence of increased muscle tension in painful muscles. They placed surface EMG sensors bilaterally over the cervical paraspinal muscles, right trapezius muscle, and right tibialis anterior muscle. Their results did not support the hypothesis of constant muscle tension in fibromyalgia; however, they speculated about the possibility that increased muscle tension may be present in other muscle groups and that the pain experienced is the result of referral pain.

Lindh, Johansson, Hedberg and Grimby (1994) found support for a hypothesis that FMS subjects ($N = 25$) exerted submaximal muscle strength when required to perform a maximal voluntary muscular contraction in isometric, concentric and eccentric tests. Surface EMG activity was recorded from the vastus lateralis and hamstring muscles while subjects were required to extend and flex their

knees. In the light of their findings, they postulated the presence of impaired control mechanisms at a supraspinal level.

Finally Svebak, Anjia, and Karstad (1993) failed to demonstrate the presence of high muscle tension in FMS when EMG activity was recorded from the forearm flexor carpi radialis area and from the upper section of the right trapezius area. The 10 female FMS patients were required to operate a joystick to control a car on a simulated computerized driving task. Stokes, Colter, Klestov, and Cooper (1993), utilizing an isometric fatigue test (performing an isometric hold against gravity with the upper body), were able to demonstrate the presence of muscle fatigue 40 seconds after muscle activation but they were unable to determine the basis for the excessive fatigue seen.

These studies have examined muscles for evidence of excessive EMG activity in FMS patients but have been unsuccessful in supporting the hypothesis that muscle dysfunction is at the basis of FMS pain.

Physiopathological Basis for Pain

Whatmore and Kohli (1974) described the manner in which pathology in physiological processes could manifest itself in a variety of functional disorders. Several common features can be seen in these disorders. With regards to human muscles, physiopathological or dysponetic responses could occur because of inappropriate muscle bracing. Such bracing may have been appropriate in a certain situation or at a certain stage of life but with continued maintenance leads to pain related concerns.

Pain can result if a muscle or group of muscles becomes activated when there is no need for such activation. Sustained hyperactivation of muscles serves to drain energy reserves and can result in fatigue spasm in the muscle.

Dysponetic functioning can also result from loss of a muscle's inhibitory potential on an antagonistic muscle. The resulting muscle activity leads to the pain-spasm-pain cycle (Travell, 1976; Cram & Engstrom, 1986) evident in so many pain patients. Hudzinski and Lawrence (1990) report that in 70% to 90% of patients presenting with temporomandibular disorder the facial pain is due to a primary or secondary muscle disorder. Whatmore and Kohli (1979) state that sustained bracing in back and neck muscles is a common cause of backache and tension headaches. Donaldson (1989) demonstrated that correction of such muscle bracing in back muscles could effectively take place using biofeedback with resultant decreases not only in dysponetic functioning but also in pain levels. If excessive muscle tension, inappropriate bracing, or loss of a muscle's inhibitory control are at the basis of the muscle related pain it is feasible to ask if dysponetic mechanisms are at the root of the musculoskeletal pain experienced by FMS sufferers.

Research Hypothesis

This project examined the relevance of the theory of dysponesis (Whatmore & Kohli, 1974) to understanding the chronic pain seen in FMS. Following the theory that dysponetic muscle behavior can lead to chronic pain, the hypothesis being examined

was that there would be differences in EMG activity between a sample of FMS subjects and non-pain controls and that these differences would be evident in the FMS group as elevated EMG activity, bilateral asymmetry, and a slower return to baseline once physical activity had ceased.

In order to determine if dsyponetic muscle functioning is at the basis for the chronic pain described in FMS the muscle activity in FMS subjects was compared with that in non-pain controls to assess for dysponetic functioning in muscle tissue adjacent to or including the tender points seen in FMS. EMG activity was recorded bilaterally from three muscle groups: upper trapezius, sternocleidomastoid and brachioradialis. Information was gathered during static, dynamic, and work phases to examine for muscle bracing, failure of a muscle to return to baseline once an activity was completed, and loss of inhibitory capacity by muscle groups. Whatmore and Kohli (1979) have indicated that these three signs demonstrate the presence of dysponetic functioning in muscles.

Subjects

Twenty-five volunteers for the clinical group were obtained from the membership of a FMS Support Group and from several outpatient facilities (see Appendix A). Control group subjects were obtained from responses to posters placed in a rehabilitation hospital as well as from a university student pool (see Appendix A). All subjects were from a large city in Alberta. Control

group subjects were selected on the basis of lack of any chronic pain complaint or condition.

FMS subjects were given a human figure drawing (see Appendix B) on which the 18 tender points were marked. They were requested to have their treating physician circle those tender points present. Tender point charts were returned for all subjects and all drawings indicated the presence of 12 or more tender points. FMS subject were not requested to stop any medication or anciliary treatment regimen in which they were concomittantly involved.

Methods

The experimental technique involved with the FMS group was as follows. After collecting basic demographic data (date of birth, educational level, marital status, address, and phone number), subjects were asked to read and sign a Consent for Research participation (see Appendix C). Questions arising from the Consent form were answered. An initial visual analogue scale (VAS) reading was collected using a 10 cm. line going from No pain (0) to Unbearable pain (10). Following this, an interview was conducted to collect relevant personal and medical history about the subject (see Appendix D). An abbreviated interview was conducted with control subjects. A second VAS reading was taken following the interview. A brief explanation about the biofeedback assessment was offered and the six sites were abraded using an alcohol prep pad containing pumice. The sites included the right and left upper trapezius, approximately 10 cm horizontally from the prominence, right and left SCM, and right

and left brachioradialis, approximately 7 cm horizontally from the epicondyle. Surface EMG sensors were then applied to all sites using silver-silver chloride circular sensors on which a dab of conducting cream had been placed.

Data Collection and Analysis

Surface EMG activity was collected using a Unicomp collection program (American Biotech Corp.) installed in an IBM 386DX computer. During the static phase, subjects sat in a relaxed posture for five minutes while EMG data was collected. During the dynamic phase, subjects stood and performed an isotonic movement, that is, they put each muscle to work (i.e., shoulder shrug, turning head left/right, flexing right/left wrist while both arms suspended in a sling). In the dynamic phase, subjects stood and performed an isometric movement by lifting a 1 kg weight to a horizontal position, shoulder height.

Both experimental and control subjects sat in a relaxed posture for five minutes while readings of EMG amplitude were collected from the upper trapezius. Readings were then collected from the SCM and brachioradialis muscle, again during a five minute period of relaxation. Subjects stood while readings were again recorded as each muscle was put into action. Activity from the upper trapezius region was recorded during a bilateral shoulder shrug (five repetitions slowly over a 30 second period). Activity from the SCM region was recorded during five repetitions of turning the head to the left then back to centre, followed 15 seconds later by five repetitions of turning the head to the

right. Activity from the brachioradialis muscle was recorded during five repetitions of a left wrist flexion and 15 seconds later by a right wrist flexion. Both arms were suspended in an elastacized sling which allowed the forearms to rest comfortably in a horizontal position. All dynamic periods were preceded, separated, and ended by a 15 second period of muscle relaxation.

During the work phase, EMG readings were taken bilaterally from the upper trapezius and brachioradialis while subjects were standing and slowly lifting a 1 kg weight to shoulder height, then dropping the arms to a vertical position, five times over a 30 second interval.

Prior to completion of the assessment session, subjects from both groups completed Part III of the Multidimensional Pain Inventory (Kerns, Turk, & Rudy, 1985). This section, measuring Daily Behaviors, provides information on an individual's ability to do household chores, outdoor work, participate in activities away from home, and social activities, as well as providing an index of general activity level.

The 5-minute average for the EMG signal (amplitude) from each muscle site was compared between the two groups using Levene's t-test for equality of variances. Comparisons between each muscle site were made for the relaxation phase, for the dynamic phase, and for the work phase. Comparisons during the dynamic and work phases were made on the average EMG reading conducted over the 30 seconds when the specific activity was in progress.

Results

Demographic and VAS Readings

Mean age and educational levels for the two groups are summarized in Table 3-1.

There was a significant difference in pain levels between the groups because of the definition of non-pain group membership; however, there was no significant difference in VAS readings taken for each FMS subject across the two hour interval of the assessment session. There appeared to be much more variability within FMS subjects than across time. In fact, the mean VAS score increased slightly for FMS subjects across the assessment session as can be seen in Table 3-2. This increase was not significant. The increase evident may have been due to the subjects' having to maintain a relatively static posture during the two hours required for history taking and data collection.

EMG Readings: Static, Dynamic, Work Phase

Results for the differences between EMG readings across the two groups during the relaxation phase are presented in Table 3-3. A 2-tailed t-test for equality of means demonstrated that there was no significant difference in EMG readings across the six sites.

Further analysis demonstrated an effect size difference for right and left upper trapezius but not for the remaining four muscle sites.

Results for the differences between EMG readings across the two groups during the dynamic phase are presented in Table 3-4. A

Table 3-1

Demographic Variables for FMS Group and Non-pain Control Group

	FMS Group (n=25)		Non-pain Control Group (n=20)	
Variable	Mean	S. D.	Mean	S. D.
Age	44.00	8.92	39.70	10.34
Educational Level	12.80	1.63	15.05	2.21

Table 3-2

VAS Readings for FMS subjects Across Time During Assessment Session

Assessment Session	Mean	S. D.	F	p
Pre-interview	4.264	2.358		
Post-interview	4.496	2.349	-.4171	.6613
Post-EMG Assessment	4.624	2.383		

Table 3-3

Bilateral EMG Readings for Upper Trapezius, SCM, and Brachioradialis Muscle for FMS and Control Groups During Relaxation Phase

Muscle	FMS Group Mean	FMS Group S. D.	Control Group Mean	Control Group S. D.	p
Left Upper Trapezius	5.40	7.76	2.98	.79	.13
Right Upper Trapezius	6.14	11.28	3.51	1.27	.31
Left SCM	6.70	7.49	4.97	2.33	.33
Right SCM	6.75	8.19	5.18	3.56	.43
Left Brachioradialis	4.82	3.84	3.46	4.18	.26
Right Brachioradialis	3.98	1.94	3.24	1.98	.22

Table 3-4

Bilateral EMG Readings for Upper Trapezius, SCM, and Brachioradialis Muscle for FMS and Control Groups During Dynamic Phase

	FMS Group		Control Group		
Muscle	Mean	S. D.	Mean	S. D.	p
Left Upper Trapezius	53.13	68.54	56.03	30.12	.860
Right Upper Trapezius	51.22	41.73	58.26	35.45	.550
Left SCM	34.67	40.02	44.85	20.13	.310
Right SCM	24.54	19.71	43.80	21.31	.003
Left Brachioradialis	101.52	56.41	104.96	48.46	.830
Right Brachioradialis	113.79	51.28	122.54	60.21	.600

significant difference between the two groups was evident only for the right SCM.

Results for the differences between EMG readings across the two groups during the work phase are presented in Table 3-5. No significant differences were obtained for any of the four muscle sites being studied. No effect size difference was evident on this portion of the study.

Muscle Symmetry

Results are presented in Table 3-6 for the differences in muscle symmetry for the three muscle groups in the relaxation phase. No significant differences were evident when the right-left differences between FMS and Control Group were compared.

Analysis demonstrated that there were no significant differences between the FMS and non-pain control group in bilateral asymmetry during the dynamic phase (Table 3-7) or during the work phase (Table 3-8).

The difference in EMG signal across the muscle sites between the two groups during the relaxation phase (see Table 3-3) is somewhat misleading. Two subjects in the FMS group exhibited readings which were significantly higher than seen in other subjects. If EMG readings from these two subjects are removed, the differences between the two groups becomes even smaller. Additionally the standard deviations for the FMS group across the six sites also decreases. These two subjects also exhibited inordinately high EMG readings during the dynamic and work phases.

Table 3-5

Bilateral EMG Readings for Upper Trapezius and Brachioradialis Muscle for FMS and Control Groups During Work Phase

	FMS Group		Control Group		
Muscle	Mean	S. D.	Mean	S. D.	p
Left Upper Trapezius	52.15	82.21	69.33	45.65	.41
Right Upper Trapezius	48.03	42.02	67.69	39.25	.12
Left Brachioradialis	45.47	21.33	50.78	18.67	.39
Right Brachioradialis	54.65	42.02	57.34	24.08	.80

Table 3-6

EMG Right-Left Differences for Upper Trapezius, SCM, and Brachioradialis During Relaxation Phase

Muscle	FMS Group		Control Group		
	Mean Difference	S. D.	Mean Difference	S.D.	p
Upper Trapezius	1.72	4.25	0.78	1.01	.34
SCM	2.68	4.51	2.03	3.05	.58
Brachioradialis	2.30	3.58	1.57	3.32	.49

Table 3-7

EMG Right-Left Differences for Upper Trapezius, SCM, and Brachioradialis During Dynamic Phase

Muscle	FMS Group Mean Difference	S. D.	Control Group Mean Difference	S.D.	p
Upper Trapezius	24.34	34.96	18.02	12.70	.48
SCM	16.53	21.95	15.69	13.53	.88
Brachioradialis	26.52	29.54	27.95	30.22	.73

Table 3-8

EMG Right-Left Differences for Upper Trapezius and Brachioradialis During Work Phase

Muscle	FMS Group		Control Group		
	Mean Difference	S. D.	Mean Difference	S.D.	p
Upper Trapezius	24.04	53.68	29.11	28.30	.70
Brachioradialis	17.58	29.33	11.00	9.74	.34

Activity Level

In examining the data from the Multidimensional Pain Inventory, date presented in Table 3-9 indicates that there were significant differences in three of five categories. Subjects suffering from FMS demonstrated significantly lower levels of activity in areas of outdoor work, activities away from home, and general activity level.

Discussion

The results from the assessment study indicate that there were no significant differences between the FMS and non-pain control group in EMG readings from the three bilateral muscle sites adjacent to or containing tenderpoints. Furthermore, there was no significant difference in readings when each subject was assessed while they sat in a relaxed posture, while they put each muscle to work, or while they performed a piece of work (lifting a 1 kg weight while standing). Dysponesis, in the form of neuromuscular signaling errors was not in evidence in FMS patients. Thus there is no evidence to support the three hypothesis outlined above.

As a test of the theory of dysponesis these results reject the theory as a model for the assessment of FMS. The data obtained provide no support for the presence of muscle bracing in FMS. Neuromuscular dysfunction is not the basis for the chronic pain experienced in FMS. Furthermore the findings demonstrate that FMS is an illness that is very different from psychophysiological disorders such as tension headaches, low back

Table 3-9

MPI Scores for FMS and Control Groups

Activity	FMS Group Mean	FMS Group S. D.	Control Group Mean	Control Group S. D.	p
Household Chores	3.89	1.21	4.31	1.42	.2900
Outdoor Work	1.02	1.08	1.76	.87	.0200
Activities Away from Home	2.51	.80	3.60	.93	.0001
Social Activities	2.50	1.20	2.82	1.00	.3500
General Activity Level	2.48	.78	3.13	.74	.0060

pain and temporomandibular disorder. Dysponetic muscle functioning has been demonstrated in these psychophysiological disorders and successful correction of such dysponesis using EMG biofeedback techniques has been reported throughout the literature.

An examination of the frequency of the EMG signal using spectral analysis could provide a more detailed picture of EMG activity. Such information would control for the subject's volitional state, as frequency of the EMG signal lies outside conscious control.

There are differences in the nature and type of psychosocial and mechanical stressors between the FMS and the non-pain control group in this study. Such differences have been examined at greater length in the literature (Latham & Davis, 1994) to determine the possible contributions which psychosocial issues, injuries or mechanical stressors might contribute to the development of FMS. Despite such great variations in the experience of pain between FMS sufferers and people experiencing no pain, the contribution which psychosocial and mechanical stressors make to peripheral EMG activity is nonexistent given the results of this study. Many people suffering from FMS continue to work at jobs albeit in modified formats (Henriksson, 1994). If dysponetic functioning would be evident in the muscles of FMS sufferers, then one would expect evidence of excessive physiological energy expenditure in muscles. While fatigue is evident in FMS sufferers, there is no evidence of excessive energy

expenditure. The high degree of variability in EMG activity in both groups studied suggests that there is much individual difference in muscle activity in both a pain and a non-pain population.

Information gleaned from the history portions of the current study demonstrated the presence of multiple stressors in the subjects' medical, psychosocial, and family background. As difficult as such research might be, controlling for some of the features seen in these histories of the FMS subjects might bring one closer to teasing out the contribution which specific factors make to the chronic pain picture seen in FMS. These included many of the stressful life events listed by Holmes and Rahe (1967) in their Social Readjustment Rating Scale. Determining such covariance could also offer grounds for understanding the ongoing debate in the psychiatric community which views depression as being an important precursor to FMS.

Sleep research which demonstrates that it is possible to create FMS-like symptoms through interruption of Stage IV sleep (Moldofsky, Scarisbrick, England, & Smythe, 1975) has contributed somewhat to understanding the neurological dynamics in FMS. Current research examining the possibility of FMS being caused by disturbances of the neuroimmunoendocrinological system (Olin, 1995) may shed further light on these specific causative factors and triggers. Both of these lines of research rest on FMS chronic pain as being centrally based, that is that the pain exists

because of a dysfunction in the central processing of the pain signal.

Inferring psychologically significant features from physiological signals still requires much refinement. In particular, the varieties of psychophysiological relations within humans are in need of comprehensive conceptual models before we can answer the complex issues relating psychological processes to physiological events (Cacioppa & Tassinary, 1990). Given that psychological and physiological factors are centrally based and mediated, it is logical that examination of and research on central mechanisms should continue in attempts to understand the nature of the chronic pain seen in FMS.

Future research on muscle activity in FMS would do well to examine the EMG signal in greater detail. Examination of the frequency of the signal using spectral analysis as well as examining the median EMG signal (Merletti, Sabbahi, & De Luca, 1984) could shed further light on the relation of muscle activity to centrally based parameters (e.g., level of various neurotransmitters, immune system function).

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Running head: BIOFEEDBACK TREATMENT

Biofeedback Treatment of Fibromyalgia Syndrome

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BIOFEEDBACK TREATMENT OF FIBROMYALGIA SYNDROME

In recent years, the acceptance of chronic pain as an affliction which is affecting increasing numbers of people has led to consideration of various treatment paradigms which fall outside the scope of medicine. Fibromyalgia Syndrome (FMS) is one illness which has demonstrated remarkable resilience to treatment efforts directed at alleviation of the chronic pain and fatigue component of the illness. Psychological treatment techniques have been advanced as possible options available to people suffering from different chronic pain illness (Sternbach, 1982). Various psychological techniques have been utilized in the management of chronic pain. These techniques have also been applied to treating the pain which is a key feature in FMS. Interventions include cognitive behavior modification (CBM), hypnosis, and biofeedback. Each of the techniques has been subjected to study however numerous questions remain and continue to guide research in this area.

This study will examine the usefulness of electromyographic (EMG) biofeedback in the treatment of the pain component of FMS. More specifically the slow return to baseline of the EMG signal after a muscle has exerted itself will be the focus of treatment. The theory of dysponesis (Whatmore & Kohli, 1974) points to a slow return to resting baseline as being one component of muscle bracing which can underlie chronic pain stemming from musculoskeletal problems.

EMG Biofeedback in Chronic Pain Treatment

A considerable body of research examining the efficacy of EMG biofeedback in chronic pain management is available. The role of this technique in the area of neuromuscular re-education has been demonstrated (Inglis, Campbell, & Donald, 1976; Middaugh, 1978; Tries, 1989). Early use of EMG biofeedback demonstrated significant decreases in depressive symptomatology and this was thought related to the increased sense of mastery over one's environment which biofeedback fostered (Hendler, Derogatis, Avella, & Long, 1977). EMG biofeedback used to foster relaxation initially received mixed reviews (Davis, 1980; Qualls & Sheehan, 1981), however, later studies demonstrated the value of EMG biofeedback in aiding relaxation (Flor, Haag, Turk, & Koehler, 1983; Health and Policy Committee, 1985; Large & Lamb, 1983). Its value in decreasing chronic pain of a musculoskeletal nature was not as evident and further research in this area was suggested (Jessup, 1990). Flor & Birbaumer (1993) demonstrated that short-term EMG biofeedback had positive effects for chronic pain patients with musculoskeletal pain when compared against CBM or conservative medical treatment.

Ferraccioli et al. (1987) applied EMG biofeedback to the treatment of six FMS patients. When results were compared with that from six patients who received false EMG biofeedback, FMS patients who received 15 sessions of EMG biofeedback (frontalis muscle) demonstrated significant decreases in the number of tender points, minutes of morning stiffness, and perception of pain

(measured with VAS). These decreases were maintained at six months follow-up.

Physiopathological Basis for Pain

Whatmore and Kohli (1974) described the manner in which pathology in physiological processes could manifest itself in a variety of functional disorders. Several common features can be seen in these disorders. With regards to human muscles, physiopathological or dysponetic responses could occur because of inappropriate muscle bracing. Such bracing may have been appropriate in a certain situation or at a certain stage of life but with continued excessive neurostimulation, the muscle bed begins to fatigue and develop pain. Pain can result if a muscle or group of muscles becomes activated when there is no need for such activation. Sustained hyperactivation of muscles serves to drain energy reserves and can result in fatigue spasm in the muscle.

Dysponetic functioning can also result from loss of a muscle's inhibitory potential on an antagonistic muscle. The resulting muscle activity leads to the pain-spasm-pain cycle (Cram & Engstrom, 1986; Travell, 1976) evident in so many pain patients. Hudzinski and Lawrence (1990) report that in 70% to 90% of patients presenting with temporomandibular disorder the myofascial pain is due to a primary or secondary muscle disorder. Whatmore and Kohli (1979) state that sustained bracing in back and neck muscles is a common cause of backache and tension headaches. Donaldson (1989) demonstrated that correction of such muscle

bracing in back muscles could effectively take place using biofeedback with resultant decreases not only in dysponetic functioning but also in pain levels.

A failure to return an activated muscle to a resting baseline is a third mechanism which can lead to pain. In this instance a muscle continues to exert an elevated EMG signal despite the lack of any activity requiring the elevated level of muscle exertion.

If excessive muscle tension, inappropriate bracing, slow return to baseline after activity or loss of a muscle's inhibitory control are at the basis of the muscle related pain it is feasible to ask if dysponetic mechanisms are at the root of the musculoskeletal pain experienced by FMS sufferers.

While studies have evaluated a subject's ability to decrease pain in FMS by relaxing certain muscle groups, no studies have utilized a dynamic protocol to determine the relationship, if any, which dysponetic mechanisms might have to the sensation of pain. Muscle bracing leads to pain because an individual is exerting a muscle when there is no longer any need to exert that muscle. Using a dynamic protocol, it is expected that a muscle should return to low baseline levels once an the activity requiring input from that specific muscle ceases. In subjects with FMS, it is expected that because of muscle bracing, the return of a muscle to baseline after an activity requiring that muscle had ceased would occur very slowly and thus would constitute evidence of a dysponetic mechanism underlying the sensation of pain in that subject.

Research Hypothesis

This project tested the utility of the theory of dysponesis (Whatmore & Kohli, 1974) to understanding the chronic pain seen in FMS. Whatmore and Kohli (1979) have indicated that muscle bracing, failure of a muscle to return to baseline once an activity was completed, and loss of inhibitory capacity by muscle groups are three mechanisms which demonstrate the presence of dysponetic functioning in muscles. Following the theory that slow return to baseline after muscle activity is one sign of dysponetic muscle bracing, the hypothesis being examined was that EMG biofeedback of the brachioradialis and/or upper trapezius muscle could lead to a decrease in muscle bracing and as a consequence a decrease in perceived pain. While there has been no evidence of FMS presenting with different degrees of severity, the five subjects chosen presented with differing degrees of muscle activity to investigate if in fact this variable was an important one in treatment protocols.

Two other variables which were measured included perceived level of pain, as measured by a Visual Analogue Scale, and ability to participate in different daily behaviors, as measured by the Multidimensional Pain Inventory (Kerns, Turk, & Rudy, 1985). The hypothesis being examined with these two variables was first that the treatment protocol would lead to a decrease in VAS readings across the 12 sessions, and second that ability to undertake various daily behaviors would improve across the 12 sessions.

Method

Five subjects were selected from a group of individuals diagnosed with FMS for EMG biofeedback treatment. The larger sample of FMS subjects had been involved in an assessment study in which EMG readings from three muscle groups proximal to tender points were compared with similar readings taken from a non-pain control sample. The five subjects from the FMS group were selected as follows. The mean reading plus two standard deviations for each muscle group of a non-pain control was calculated. Each FMS subject's EMG signal was then compared against these readings. Subjects chosen for treatment included two FMS subjects who had readings greater than 2 standard deviations above the mean of the non-pain controls at six or more of the condition by muscle sites. Two FMS subjects had readings greater then 2 standard deviations at three of the sites. One FMS subject had no readings greater than 2 standard deviations from the mean of any site.

These five subjects were seen on a biweekly basis for 12 sessions. Each session was 45 minutes in length. Biofeedback was utilized as an educative tool to make subjects aware of the relationship between the EMG signal and posture, psychosocial stressors, and ergonomic factors. During the initial six sessions maintenance of a low EMG signal in the brachioradialis and/or upper trapezius muscle was the main focus of biofeedback. The subjects received four 5-minute training trials during each of the first six sessions.

A dynamic activity was then introduced. During the final six sessions, one or two of the 5-minute training trials included 30 second periods of typing at a computer keyboard. During the last 5-minute training trial of sessions 7 - 12 they were then asked to lower the EMG readings back to baseline levels. It was expected that the FMS subjects would demonstrate difficulty in returning EMG activity in the two muscle groups to baseline levels, that is, to levels evident during the first 5-minute trial of each session. VAS scores were obtained at the beginning and at the end of each treatment session.

Subjects were asked to complete a portion of the West Haven-Yale Multidimensional Pain Inventory (MPI) (Kerns, Turk, & Rudy, 1985) following session 1 and following session 12. The MPI was developed to assess the effect which chronic pain has on an individual's ability to carry on with a variety of daily activities. The portion of the MPI which was utilized as part of this study assessed the person's ability of do household chores, outdoor work, participate in activities outside the home and engage in social activities. A score for general level of activity was derived from an average of the four scores from the four activity areas. Readings derived from this questionnaire go from a low of 0, indicating a total inability to participate in daily activities to a high of 6, indicating an ability to always manage the behavior. Additionally, they were asked to have their spouse, adult child, or boyfriend complete the questionnaire at the same time. Means and standard deviations for chronic pain

samples have been published (Kerns, Turk, & Rudy, 1985) and for the portion of the MPI used, lie below 2.80 for a heterogeneous chronic pain sample of 500 subjects for all categories.

Instruments

Integrated EMG (iEMG) signals were collected on an IBM compatible 386DX computer utilizing Unicomp Biofeedback software (American Biotec Corporation) with four channels using m-501 J & J modules for EMG signal collection. Subject preparations included: cleansing of the skin surface where the sensor was to be attached and attachment of all bilateral sensors to the four muscle sites prior to data collection. Readings obtained represented the magnitude of the EMG signal and was measured in microvolts.

Data Analysis

Data analysis involved an examination of the ability of each subject to return the left and right brachioradialis and/or upper trapezius muscle to the baseline level obtained in the first trial of the session after they were required to type at a computer keyboard for two 30-second periods during the second and/or third 5-minute trial of the session. Each session was 45 minutes in length. The activity of typing at a keyboard does require the recruitment of the brachioradialis and upper trapezius muscles. This information was derived from sessions 7 - 12 during which a dynamic activity was introduced. On Figures 4-1 to 4-7 the trials which included the two 30-second intervals of keyboard typing are labelled 'w' while the trials which did not include keyboard typing are labelled 'r'. Sessions 1 - 6 did not utilize a dynamic

Figure 4-1. Mean EMG signal per 5-minute trial for Subject C during dynamic protocol.

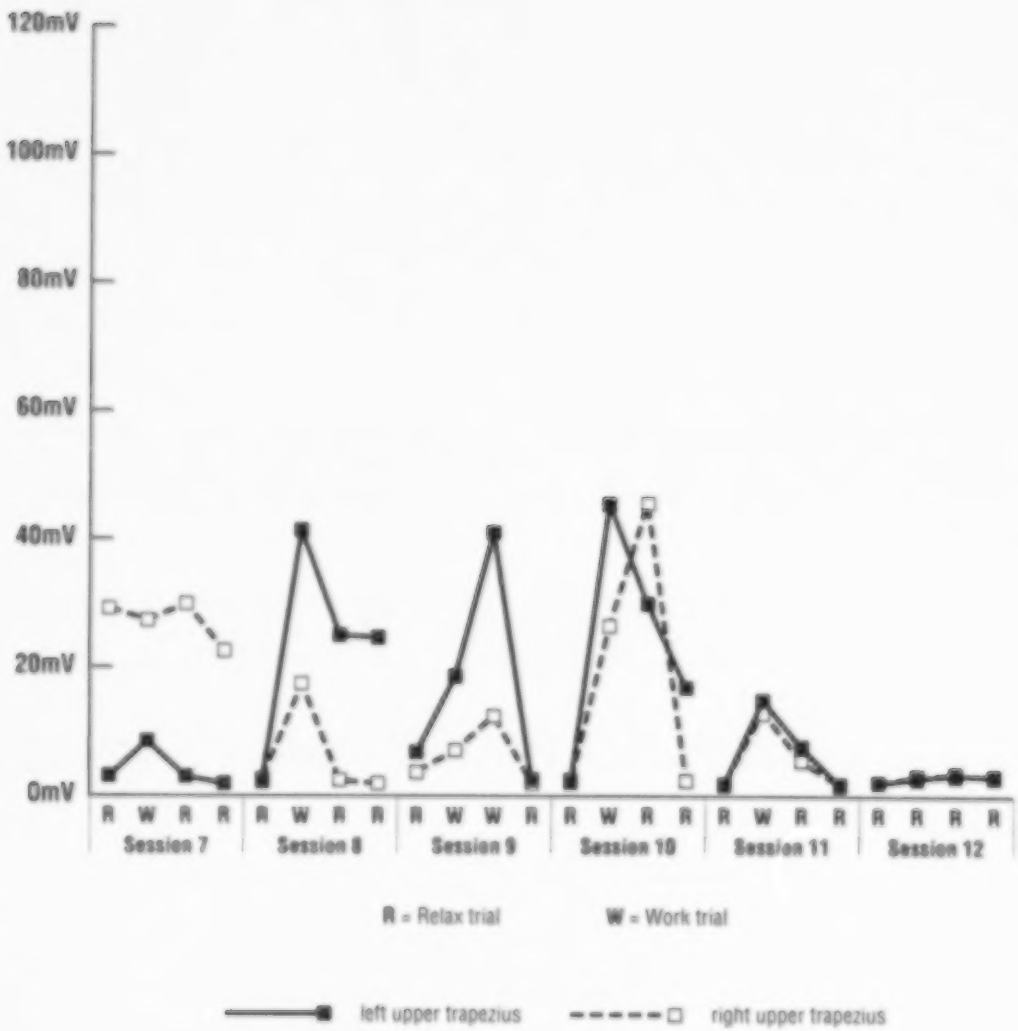


Figure 4-2. Mean EMG signal per 5-minute trial for Subject C during dynamic protocol.

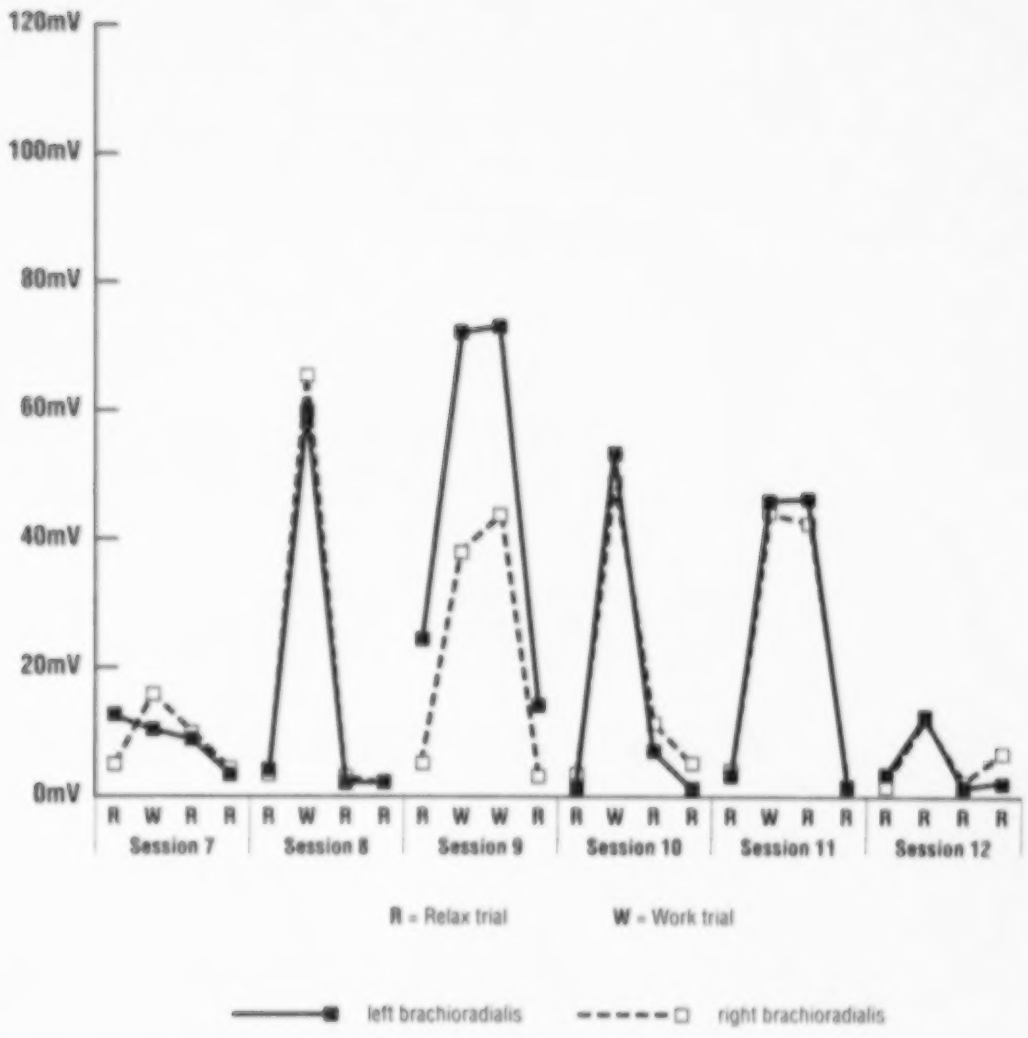


Figure 4-3. Mean EMG signal per 5-minute trial for Subject E during dynamic protocol.

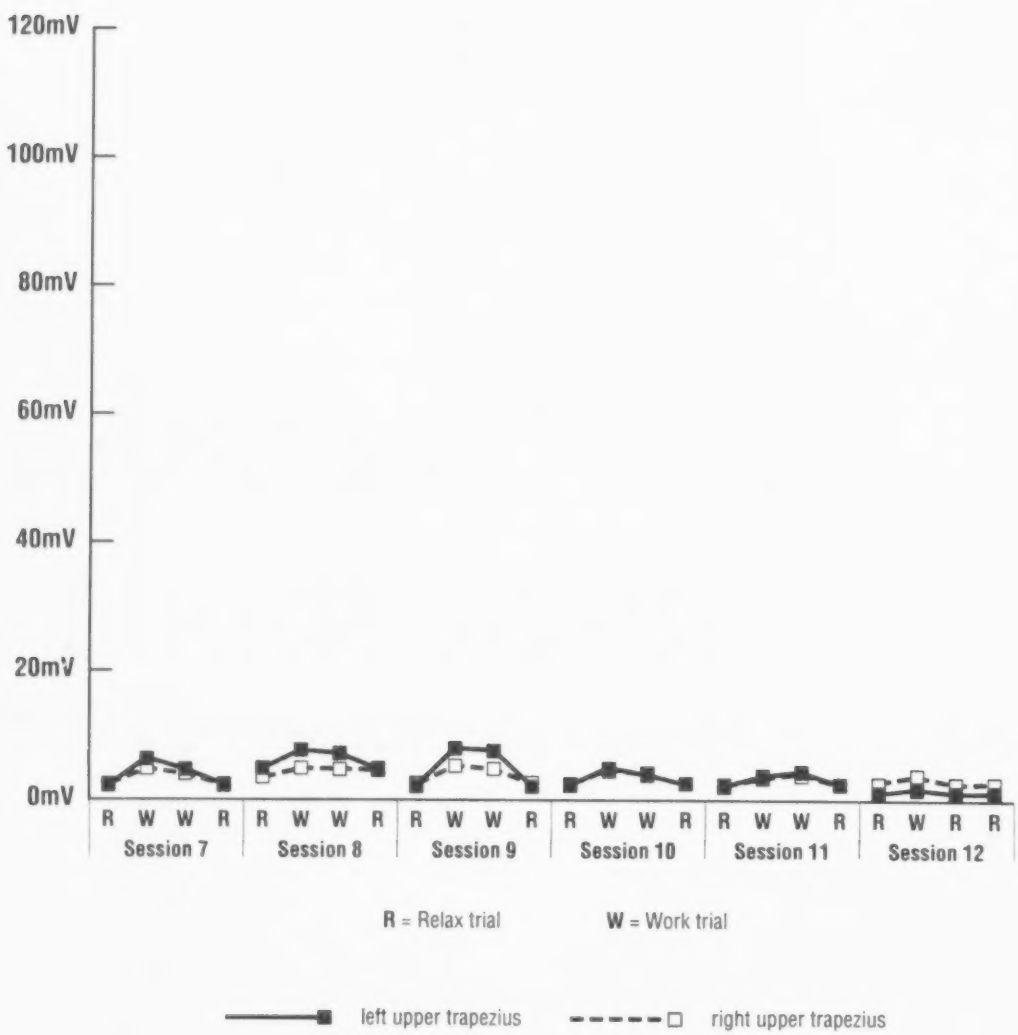


Figure 4-4. Mean EMG signal per 5-minute trial for Subject E during dynamic protocol.

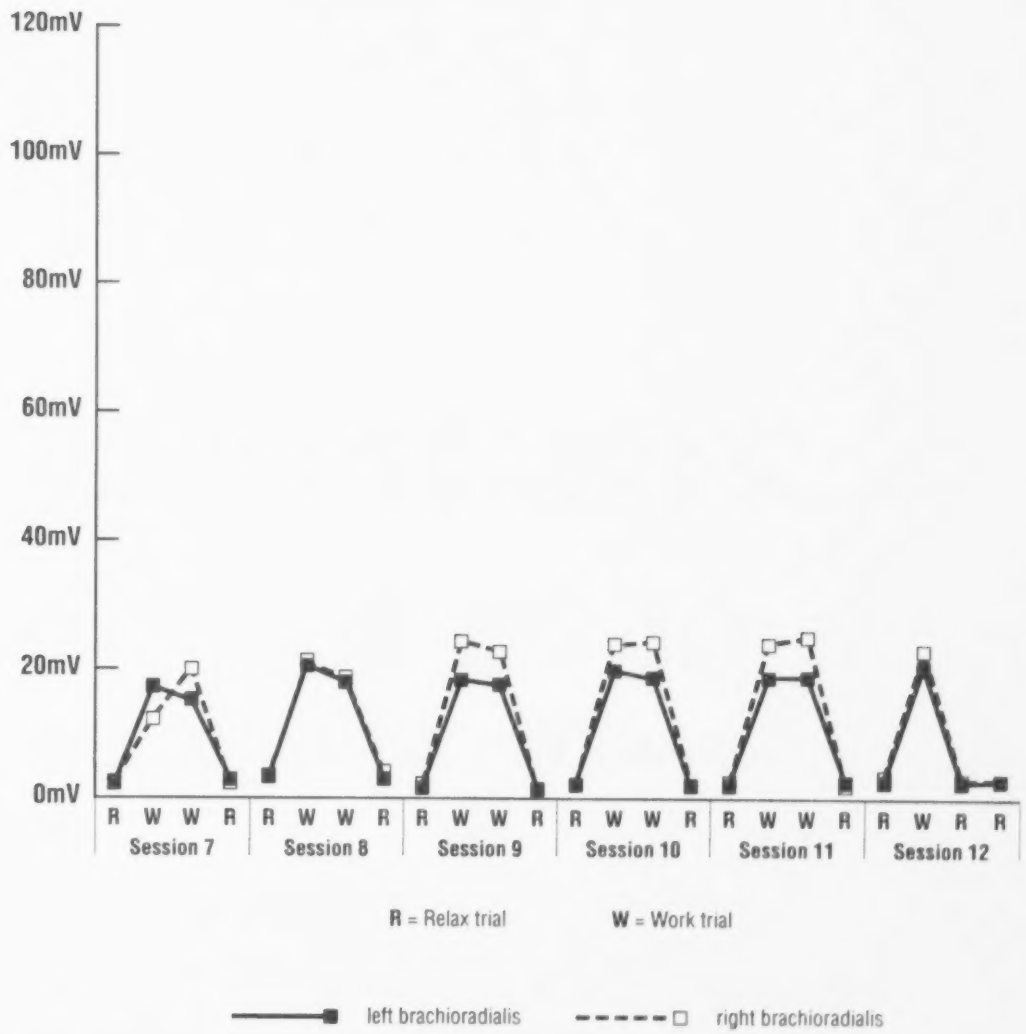


Figure 4-5. Mean EMG signal per 5-minute trial for Subject G during dynamic protocol.

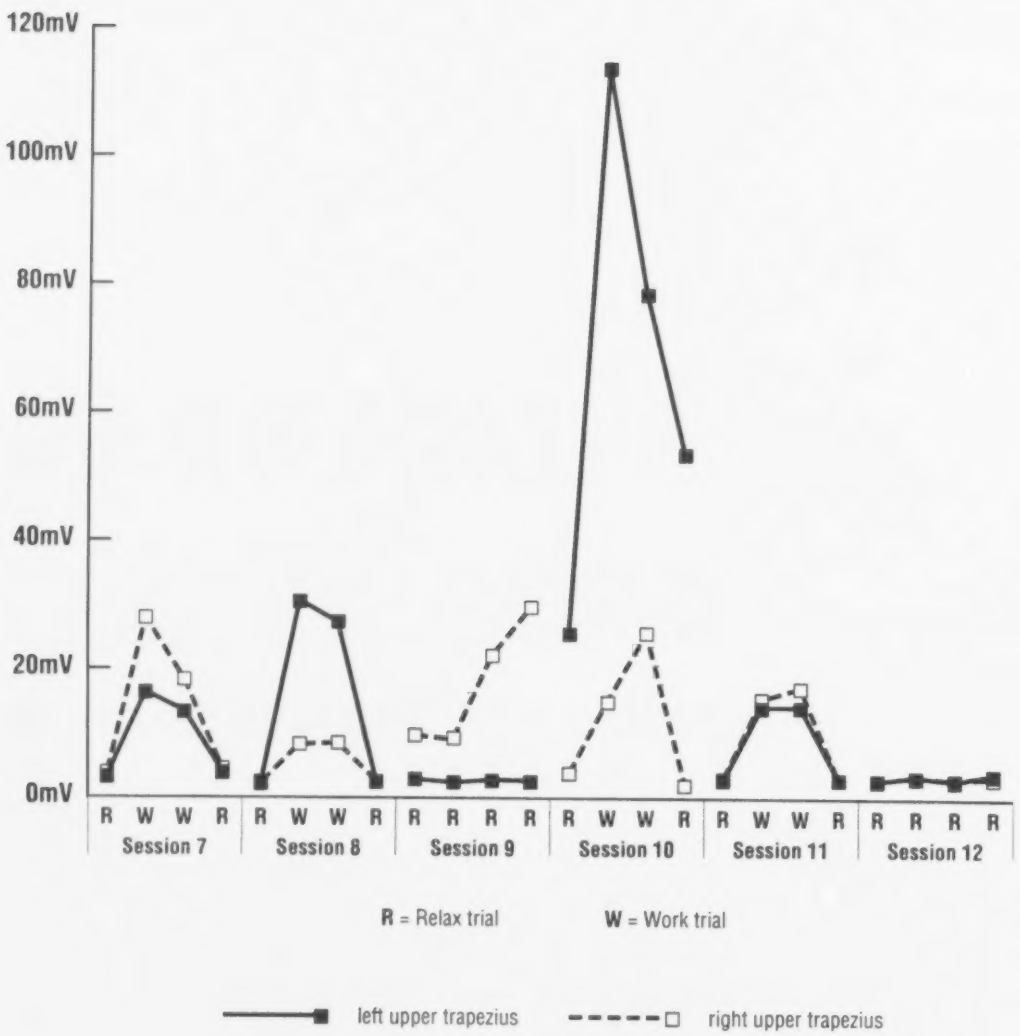


Figure 4-6. Mean EMG signal per 5-minute trial for Subject M during dynamic protocol.

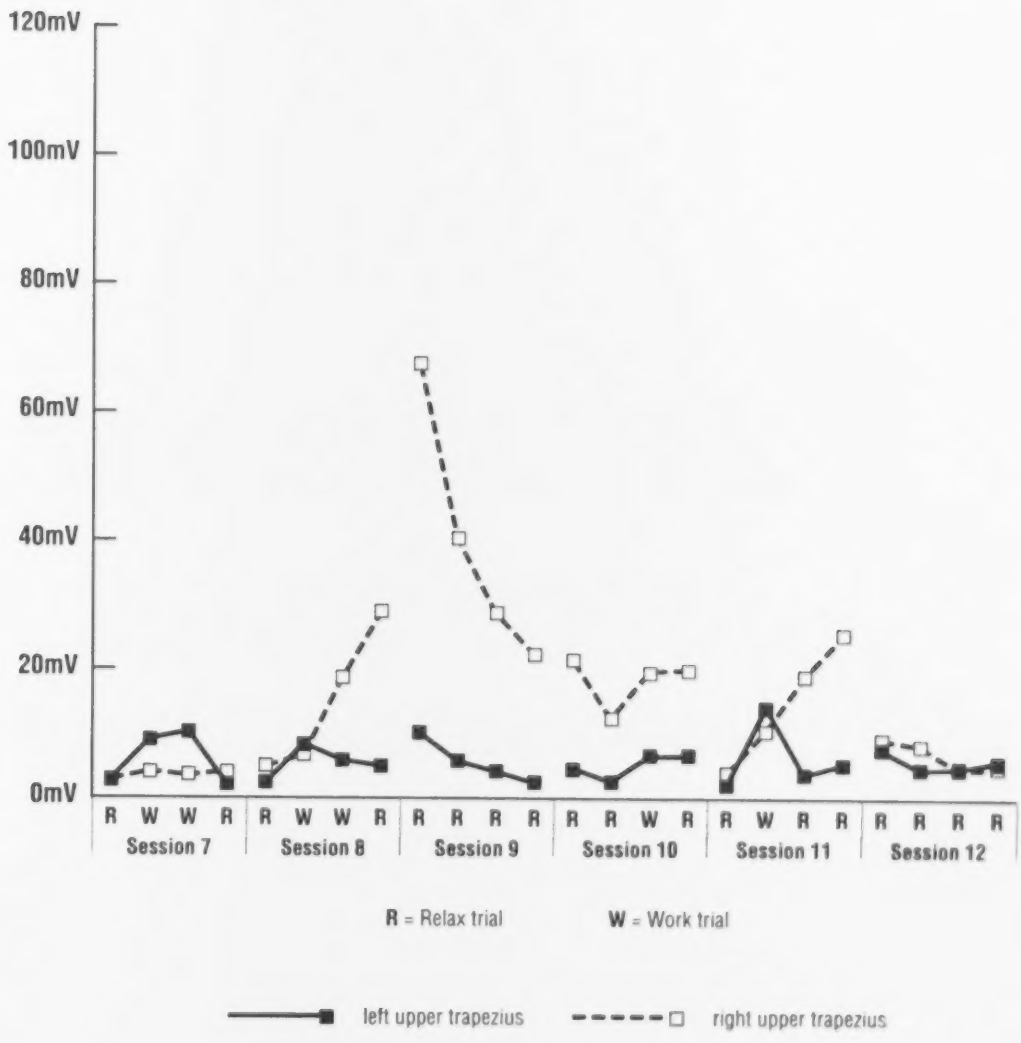
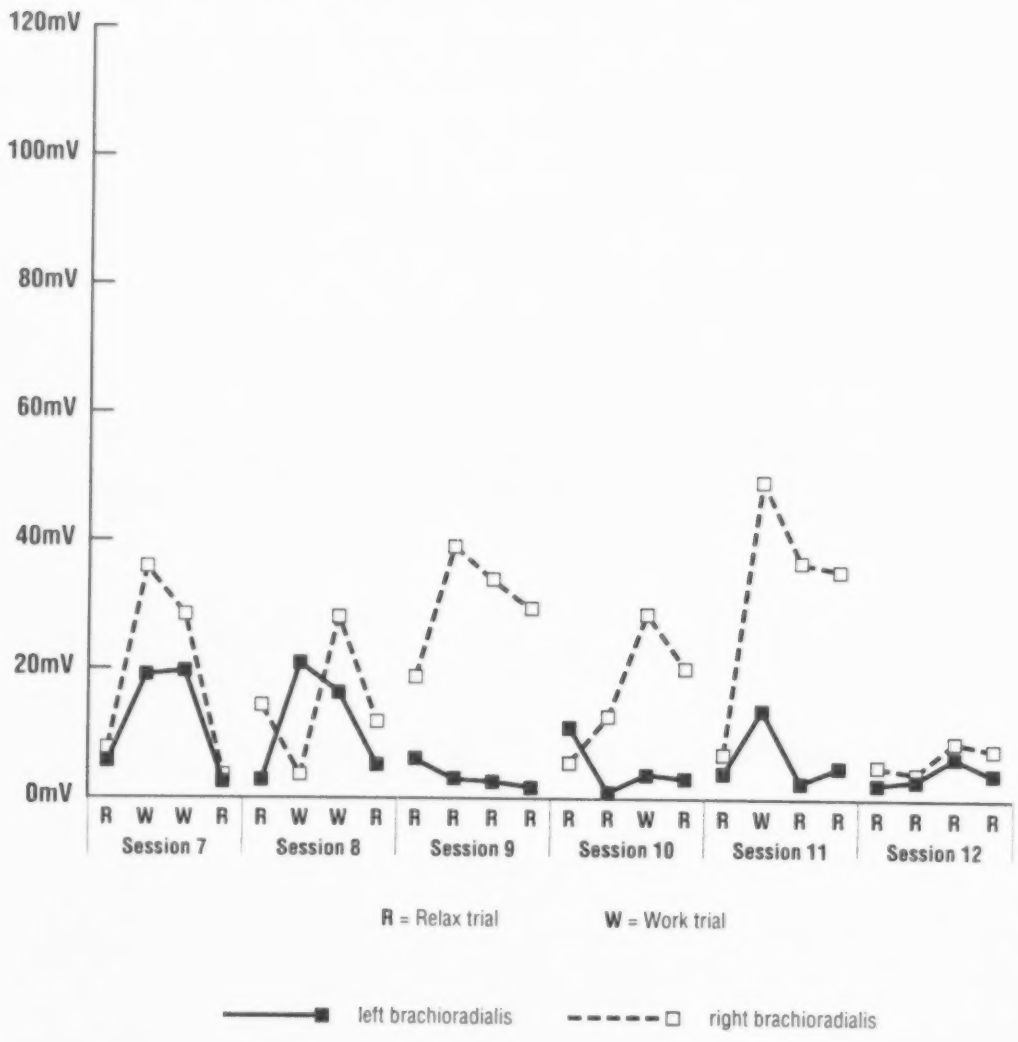


Figure 4-7. Mean EMG signal per 5-minute trial for Subject M during dynamic protocol.



protocol but focused rather on maintaining a low level of EMG activity. Any change in perceived pain intensity and changes in activity level both inside and outside the home for each subject were also examined. An examination of the return to baseline of the mean EMG signal across treatment sessions is presented in graphical form in Figures 4-1 to 4-7. Changes in the VAS score of the five subjects across treatment sessions were also examined and compared with the VAS scores obtained in Study 1. Ability to partake in daily activities was examined utilizing a portion of the MPI.

Results

Brief histories of each subject are presented in Appendix E. Descriptive data for each of three subjects is presented in two graphs. For these three subjects the first graph represents readings of the mean EMG signal from the right and left upper trapezius muscle for 5-minute session of relaxation (R) and a 5-minute session when the subject was required to type at a computer keyboard (W) for one or two 30-second intervals. The second graph presents readings of the mean EMG signal from the right and left brachioradialis muscle for the same sessions. For Subject G, readings were taken bilaterally only from the upper trapezius muscles as she did not voice any complaints about pain in her arms.

Data was rejected for one subject (Subject A; see Appendix E). EMG readings for this subject suggested the presence of continuous and severe spasm in the two sets of muscles being

examined across the 12 sessions. Given that this subject had osteoarthritis, scoliosis, and degenerative discs, the involvement of structural factors underlying the muscle abnormalities seen must be considered. A previous work-related back injury may also have played a role in the establishment of the bracing and recruitment patterns in the shoulders evidenced with the elevated muscle activity in her upper trapezius and brachioradialis muscles. The difficulty in separating out the contribution of each component could not be overcome with this subject in the current study.

Figures 4-1 to 4-7 present in graphical form the mean EMG signal for Subjects C, E, G and M for each 5-minute period of relaxation (R) and for each 5-minute period during which a dynamic protocol (W) was introduced.

Tables 4-1 and 4-2 present the pre-treatment and post-treatment Visual Analogue Scale (VAS) score for subjects C, E, G, and M for each of the 12 treatment sessions. Tables 4-3 and 4-4 contain the MPI scores on daily behaviors for Subjects C, E, G, and M.

Subject C

With the exception of the first two dynamic sessions, Subject C demonstrated good ability to return her upper trapezius and brachioradialis muscles to a resting baseline after working on a computer keyboard (see Figures 4-1 and 4-2). Her level of pain as measured by the VAS (see Table 4-1) fluctuated throughout the 12 sessions and did not appear to be related to her ability to return

Table 4-1

Visual Analogue Scale (VAS) Reading for Subjects C and E

(Range = 0-10)

Day	Pre-Treatment	Post-Treatment
Subject C		
1	7.0	5.3
2	6.7	5.7
3	5.0	4.7
4	4.5	2.8
5	2.5	3.0
6	4.6	3.8
7	5.4	5.9
8	7.1	6.6
9	3.2	4.0
10	3.7	3.4
11	1.4	3.4
12	5.8	5.3
Subject E		
1	3.6	2.2
2	4.8	3.5
3	2.2	3.1
4	3.2	3.0
5	2.4	2.3
6	3.8	3.4
7	4.6	4.2
8	5.5	5.3
9	3.2	3.0
10	2.9	2.4
11	4.0	3.9
12	1.6	1.8

Table 4-2

Visual Analogue Scale (VAS) Reading for Subjects G and M

(Range = 0-10)

Day	Pre-Treatment	Post-Treatment
Subject G		
1	2.5	1.3
2	3.8	0.0
3	2.1	2.0
4	4.0	2.5
5	2.2	1.0
6	2.2	1.0
7	0.9	1.4
8	2.0	0.5
9	0.8	0.7
10	0.7	0.7
11	1.0	0.7
12	0.9	0.6
Subject M		
1	7.5	7.0
2	8.7	7.0
3	5.7	4.1
4	6.1	5.0
5	5.1	5.8
6	5.8	4.4
7	5.8	5.3
8	7.4	5.5
9	6.4	4.8
10	5.0	4.7
11	4.7	5.2
12	5.2	4.5

Table 4-3

MPI Score[1] on Daily Behaviors for Subjects C and E

Activity[2]	Assessment	Pre-Treatment		Post-Treatment	
	Subject	Subject	Spouse	Subject	Spouse
Subject C					
1. Household Chores	4.60	4.60	4.20	5.00	4.20
2. Outdoor Work	1.00	0.80	0.80	1.00	0.60
3. Away from Home	2.50	2.75	3.25	3.25	2.75
4. Social	2.75	2.67	3.00	3.00	3.00
5. General Level	2.71	2.71	2.81	3.06	2.59
Subject E					
1. Household Chores	4.20	3.80	4.80	4.00	4.20
2. Outdoor Work	1.20	0.33	0.33	0.33	0.00
3. Away From Home	3.00	1.75	3.50	3.00	3.00
4. Social	2.50	2.25	2.50	2.25	2.75
5. General Level	2.73	2.03	2.78	2.39	2.49

[1] - Range 0.0 - 5.0

[2] - 1. Household chores
2. Outdoor work
3. Participate in activities away from home
4. Social activities
5. General activity level (average)

Table 4-4

MPI Score[1] on Daily Behaviors for Subjects G and M

Activity[2]	Assessment	Pre-Treatment		Post-Treatment	
	Subject	Subject	Spouse	Subject	Spouse
Subject G					
1. Household Chores	2.60	2.80	3.80	3.80	4.00
2. Outdoor Work	1.60	1.20	2.00	1.20	1.60
3. Away from Home	1.75	2.20	1.75	3.00	2.50
4. Social	2.00	2.50	2.33	2.25	3.00
5. General Level	1.99	2.13	2.47	2.56	3.78
Subject M					
1. Household Chores	1.20	2.00	2.60	1.20	3.60
2. Outdoor Work	0.33	0.20	1.50	0.20	2.00
3. Away from Home	0.50	2.25	3.00	0.75	3.00
4. Social	0.50	1.50	2.75	0.25	4.25
5. General Level	0.63	1.49	2.46	0.60	3.21

[1] - Range 0.0 - 5.0

[2] - 1. Household chores
2. Outdoor work
3. Participate in activities away from home
4. Social activities
5. General activity level (average)

her upper trapezius and brachioradialis muscles to resting baseline. On the MPI her general level of ability to manage daily behaviors increased from 2.71 to 3.06 (see Table 4.3). Her husband perceived a slight decrease in her ability to manage daily behaviors, with scores at 2.81 pre-treatment and 2.59 post-treatment. While Subject C reported that the EMG biofeedback had made her more aware of the onset of her pain whenever she was at home, there was no evidence from the treatment readings to indicate that dysponesis as indicated through failure to return a muscle to baseline played any role in her pain. An examination of the 'r' and 'w' trial in Figure 4-1 and 4-2 demonstrates that for the most part this subject was able to return left and right upper trapezius and brachioradialis to the level seen in the first trial of each 45-minute session.

Subject E

Subject E demonstrated excellent ability to return both her upper trapezius and brachioradialis muscles to baseline after working on the keyboard in each of the six treatment sessions. (see Figure 4-3 and 4-4). Her experience of pain as measured by the VAS (see Table 4-1) fluctuated throughout the 12 sessions and did not appear to be related in any way to the EMG readings. On the MPI, her general level of ability to partake of daily behaviors increased slightly from 2.03 to 2.39 (see Table 4-3). Her spouse, on the other hand, viewed her functioning in daily behavior to have dropped slightly, going from 2.78 pre-treatment to 2.49 post-treatment. Subject E reported that she used the

information available to her from the biofeedback to change the way she worked at her computer station at her job.

Subject G

With the exception of two sessions Subject G demonstrated good ability to return the muscle activity of her upper trapezius muscle to baseline levels after working on the computer keyboard. (see Figure 4-5). She was unable to account for the elevated readings during session 9 and 10 but did report that she had had treatments of dry needling for trigger point therapy in the week prior to these two sessions. Despite the high EMG readings during these two sessions she did not report increases in pain intensity. VAS readings for Subject G (see Table 4-2) remained quite low throughout the 12 sessions and did not appear to be related to EMG activity. She reported slight increases, from 2.13 to 2.56, (see Table 4-4) in her ability to be involved in daily activities although her adult daughter perceived greater increases, from 2.47 to 3.78. Subject G reported that the biofeedback had proved valuable as a learning tool to assist her in feeling she had some control over events in her life. She reported improved attitude and a readiness to return to work and said that the "EMG signal has been like a picture of my tension".

Subject M

An examination of Figure 4-6 and 4-7 indicates that Subject M had considerable difficulty in relaxing her upper trapezius and brachioradialis muscles regardless of working or relaxing the muscles. Her VAS scores (see Table 4-2) remained at moderate to

high levels throughout the sessions; however, there was fluctuation in her perception of pain over time. On the MPI (see Table 4-4) she reported a moderate drop in her ability to be involved in daily activities, with scores moving from 1.49 pre-treatment to 0.60 post-treatment. Her adult son however felt she was more capable of participation in daily activities, reporting scores at 2.46 pre-treatment and 3.21 post-treatment.

Discussion

The results obtained from these four subjects demonstrates that the musculoskeletal pain experienced in FMS is not related to the dysponetic mechanism involved in an inability to return a muscle to a baseline level of functioning after it has been put to work. Three of the subjects demonstrated quite good ability to relax the muscles after they had been required to perform a keyboard activity for a period of time. One subject demonstrated erratic EMG behavior in the muscle groups examined, with little apparent relation either to a static or dynamic protocol. Level of pain experienced did not appear to be related to EMG activity in any way. Habitual bracing patterns evidenced by excessive EMG activity and a failure to return a muscle to a baseline level of functioning does not appear to be instrumental in the maintenance of the pain. While information derived from the process notes on each subject certainly does support the complexity of the mix between psychological and physiological factors (Henricksson, Gundmark, Bengtsson, & Ek, 1992), Yunus' (1994) reference to the role of central cortical mechanisms in FMS is important to bear in

mind. Three of the four subjects in this study voiced deriving some benefit from the biofeedback treatment despite there being no evidence from the EMG readings of any evidence of dysponesis.

The hypothesis was not supported by the current data. The four subjects for whom EMG biofeedback was provided were able to return elevated EMG readings to baseline levels when required. There was no evidence that the dysponetic mechanism of slow return to baseline was in operation from the data obtained. Applying the theory of dysponesis to FMS is invalid and inappropriate. Furthermore, it would indicate that the use of EMG biofeedback in the treatment of FMS is invalid and unethical as there is no evidence of the presence of dysponesis at work.

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Running head: LIFE HISTORY IN FMS

Life History in Fibromyalgia

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LIFE HISTORY IN FIBROMYALGIA

While researchers continue to search for the common aetiological bases of fibromyalgia syndrome (FMS), it is generally accepted knowledge that the chronic pain in this illness, as in other illnesses, is an individually experienced and unique process (Henriksson, Gundmark, Bengtsson, & Ek, 1992). Some FMS sufferers are able to adapt to the effects of the pain and move on with their lives while others become overwhelmed. Research on how people perceive, experience, and cope with pain has identified personality variables (Kerns, Rosenberg & Jacob, 1994; Scudds, Rollman, Harth & McCain, 1987), cultural norms (Reid & Bush, 1990), past learning (Fordyce, 1988), and socioenvironmental factors (Sternbach, 1986; Krishnan, France & Urban, 1988) as some of the important components which must be taken into account. When pain persists and becomes an active and dominant part of a person's life, as is the case in Fibromyalgia syndrome (FMS), an individual's physical, psychological, social, and spiritual resources become taxed. These variables are embedded in the lived experience of the sufferer. Therefore the history of that lived experience has the possibility of informing us of potentially significant contributions to understanding the experience of pain in people with FMS.

The main question driving this inquiry is whether an investigation of the life history of the FMS sufferer has the potential to provide us with information which might assist in better understanding the chronic pain experience with which these

people present. Additionally does the elicited information have the potential to better guide therapeutic interventions directed at this illness? This project will compare the life histories of a group of 25 people suffering from FMS with that of 20 people free from any type of chronic pain. The examination and discussion of the life history as it relates to chronic pain will address the topic from a descriptive and subjective framework.

Following, a brief discussion of chronic pain in peoples' day-to-day functioning, data from the history of the FMS subjects will be presented and examined for common themes, dynamics, and life issues. Comparisons will be made with life history data obtained from the pain-free control group as well as with previous research findings. Finally, to address the question "are there life history events, stressors, dynamics or features which are related to the development of chronic pain in FMS and which could be used to guide therapeutic treatment?", personal observations are offered about the differences noted.

Theoretical Controversies on Chronic Pain in FMS

There are many different issues currently being debated in the literature surrounding FMS. Within the realm of diagnostic concerns, a major issue revolves around whether FMS follows or precedes depression. The corollary of this is whether, with FMS, we are dealing with a physical or psychiatric illness. Boissevain (1996) examined research from both perspectives and viewed the question as unresolved. While many FMS patients do suffer from significant levels of depression, there is an equally high number

who do not suffer from clinical levels of depression. Furthermore the level of depression observed in many patients with FMS is considerably lower than that seen in psychiatrically depressed patients. While the possibility exists of the depression in FMS being qualitatively and quantitatively different from that seen in major affective disorders, alternative options include the possibility of FMS being a separate entity as well as it being part of a broader spectrum of pain disorders.

Treatment considerations will also rest on the perspective of the therapist. While medical treatments have focused on determining the proper type and amount of medication to utilize with FMS patients, psychological perspectives tend to focus on behavioral management (Fordyce, 1976) or on a modification of cognitive coping strategies (Williams, Watts, MacLeod & Matthews, 1988). The former viewpoint stresses the need to positively reinforce desired behavior regardless of the pain inherent in an action and to negatively reinforce behavior by which the person might begin to exhibit sedentary or bedridden behavior because of the pain being experienced. The latter viewpoint attempts to change the manner in which the chronic pain patient attends to, remembers and recognizes pain-relevant information (Boissevain, 1996)

The difficulties in measuring the intangible experience of pain are many. The literature already has notable contributions in questioning the relationship between chronic pain and social/vocational outcomes. That such pain affects day-to-day

functioning in people with FMS is accepted regardless of theoretical outlook. Taking these different perspectives into account, is it possible to develop a framework from the different life histories obtained which will lead to a better understanding of the personal and pervasive effect which chronic pain has in the lives of FMS patients?

From this perspective the unique interplay of learned experiences, cultural background, physiological make-up and personality variables play an important role in determining an individual's ability to manage an excessive period or amount of chronic pain. Exploring pain within a specific life history allows for insight into the uniqueness of the pain experience. "Tell me your relationship to pain, and I will tell you who you are." (Juenger, 1934 cited in Eng, 1990, p. 63) The ability to move beyond the loss, illness, or trauma from whence the pain originates, differentiates the chronic pain sufferer who focuses on his/her past versus the sufferer who fixes his/her gaze on the future. Unfortunately an increasing number of people are loosing the ability to mediate the interaction between the chronic pain and their own unique life history such that the consequent result is incapacitating and overwhelming chronic pain.

Boissevain and McCain (1991) in discussing the experience of pain in FMS state that this illness is quantitatively and qualitatively different from other chronic pain experiences. Besides having lower pain thresholds and lower levels of pain tolerance, more FMS patients complain of widespread pain when

compared with chronic pain controls. Pain in FMS is more intense and severe. The pain experienced in FMS "is consistently rated as more severe, more emotionally complex and more physiologically debilitating than symptomatology experienced by other chronic pain sufferers." (Boissevain & McCain, 1991, p. 246). In examining pain research using visual analogue scales, questionnaires assessing psychological status, and diagnostic interview schedules, they stress the value of considering "psychological malaise as an integral consequence of the FS syndrome rather than as a concomittant marker of FS" (p. 243). In examining the psychopathological and pathophysiological aspects of FMS, it is still not possible to determine which precedes which (van Houdenhove, Vasquez, & Neerenckx, 1994). Such answers could only come from research which was able to control the extensive interplay of internal and external variables as well as for past and present variables. Despite these shortcomings in knowledge, treatment protocols continue to be developed with singular foci guided by the training of the treatment provider. Medications are prescribed by doctors; exercises are advised by physiotherapists; cognitive modifications are suggested by psychologists.

In considering the lived experience of people with FMS, Henriksson et al. (1992) surveyed 58 patients for social background, employment status, symptoms, physical training habits, patients' experience of general health, physical status, and difficulties encountered in performing motor tasks. They found that over half the sample (55%) were gainfully employed but that

they worked shorter hours and had to be much more aware of the nature of the motor performance they expected from themselves. Because of the pain and fatigue experienced, the patients were required to make major readjustments to their lifestyle. These included extra time getting started in the morning, and frequent rest periods during the day. Oftentimes leisure activities, household chores, and family maintenance activities such as shopping and clothes washing had to be curtailed or given up to spouses and other family members. Additionally, patients acknowledged requiring more willpower and motivation to overcome the debilitating effects of the pain and fatigue. In designing treatment programs for this subset of chronic pain individuals, Henricksson et al. (1992) emphasize the importance of taking into account each person's unique set of early experiences, personal values, and environmental conditions. Despite acknowledging the value of this knowledge in treating and understanding FMS, the authors say little of the early life history of the subjects in the study.

Van Houdenhove et al. (1994) point to the need to examine each FMS patient with their own "unique life story" as being as necessary as the understanding of specific physiological symptoms In two case reports, they point to the history of the subjects' poor sleep habits, in one case stemming from a patient's need to be hypervigilent after being sexually abused by her father at age 12 years. In the second case the sleep difficulties arose from

the patient's need to remain hypervigilent at night while providing care for a parent with Parkinson's Disease.

This chapter will examine historical material derived from interviews conducted with 25 FMS subjects. Additional issues explored will deal with how they live their daily lives, how they interact with people, and how they struggle to maintain a sense of control in their lives in the midst of the chronic pain brought on by FMS. Comparisons in these areas will be made with information obtained from a non-pain control group of 20 subjects. More specifically the focus in this examination will be not only to compare the life histories of these two groups of people but to search for threads connecting past and present circumstances in the FMS subjects which might enhance our knowledge of this illness.

Methodology

Twenty-five volunteers for the FMS group were obtained from the membership of a FMS Support Group and from several outpatient medical facilities (see Appendix A). Control group subjects volunteered in response to posters placed in a rehabilitation hospital and at a large university (see Appendix A). Control subjects were selected on the basis of lack of any chronic pain complaint or condition. All subjects were from a large city in Alberta.

The final group of FMS subjects was composed of 24 females and one male ($\bar{X}$ age = 44 years, s.d. = 8.92 years) while the control

group was composed of 19 females and one male (X age = 39.7 years; s.d. = 10.34 years).

Information was derived from a one hour interview guided by a questionnaire (see Appendix D) developed to assess medical and personal history, description of the pain, and features which accompany, exacerbate, or alleviate the pain. The subjects were also asked to describe in detail a typical day in their life.

The questionnaire was used to facilitate open discussion of the subject's life. Answers were written verbatim during the interview process. The free dialogue which took place was guided by the questionnaire and was conducted during the first hour of each subject's involvement in a larger study examining the usefulness of biofeedback in the assessment and treatment of FMS. The principal author, a chartered psychologist, conducted all interviews in a private counselling setting.

Analyses undertaken included subjective examination of trends as well as frequency counts on different life history variables. No formal ANOVA or MANOVA analyses were conducted.

Findings

Because of the subjective nature of the questionnaire and the preference in establishing a free dialogue during the interview with the subjects, the information obtained will be presented in a descriptive format.

FMS and Illness

FMS subjects reported experiencing a variety of illnesses and medical problems in the years leading up to or concomittant with the diagnosis of FMS (see Table 5-1). Medically related difficulties included Irritable Bowel Syndrome (40%), headaches (52%), Pneumonia (24%), Scoliosis (12%), back surgery (16%), Diabetes (12%), thyroid problems (16%), Scarlet Fever (12%), Temporomandibular disorder (12%), and Reynaud's Syndrome (12%). Three of the subjects (12%) stated that their doctors had told them they were suffering from degenerative discs or osteoarthritis.

In examining the incidence of these medical difficulties in the control group, 15% suffered from headaches and 10% from TMJ to the extent that the condition was bothersome in their daily life. All other medical problems acknowledged by the FMS subjects were not in evidence in the control group.

FMS and Psychological Illness

A recent study by Wolfe, Ross, Anderson, Russell, and Hebert (1995) found that 57% of a sample of FMS subjects had experienced a clinical depression. In considering the role of psychological illnesses with FMS, 56% of the sample in the current study admitted to at least moderate degrees of depressive symptomatology (as extrapolated from responses to specific DSM-IV symptoms of depression on the questionnaire) compared with none in the control group(see Table 5-1). Subjects reported a wide variety of depressive symptoms but the most common were a disturbed sleep

pattern, feelings of hopelessness, withdrawal and social isolation and difficulties with concentration. Fifty-two percent of the subjects were receiving psychotropic medications primarily of an anti-depressant nature while 32% were taking medications for pain control. The relationship between chronic pain, depression, and sleep disturbance has yet to be fully understood (Yunus, 1993); however, 60% of the FMS sample stated emphatically they did not experience a restorative sleep cycle. Of those subjects who occasionally did have a good night's sleep (24%), they said they seldom had a restorative sleep pattern for more than two weeks in a row. Several said antidepressants were able to help improve sleep pattern for only brief periods. No members of the control group were on anti-depressant medications but one subject was on pain control medication for a recent sports-related injury.

FMS and Work Status

While financial concerns and issues related to loss of independence were present for most individuals, 48% of the subjects reported they were working and self-sufficient (see Table 5-1). Only 24% indicated that they were reliant on social assistance, unemployment insurance, or long term disability insurance. Twenty-four percent of the sample was not working and lived in single-income families. Of the non-pain group, 95% were employed and contributing to family income. These figures are comparable with data from the Wolfe et al. (1995) study which found that in their sample of 193 FMS subjects, 80% had made no application for any type of disability assistance.

Finally, 40% of the FMS subjects indicated that prior to the diagnosis of FMS they had worked in occupations which they felt to be highly stressful. Issues in this regard ranged from working long hours on a regular basis to interpersonal conflict with employers/managers. Only 20% of the control group reported having experienced work-related stress or problems.

FMS and Physical Trauma

In exploring the degree of trauma which had occurred in the lives of these individuals, 48% had been involved in motor vehicle accidents (MVA) in the months preceding the onset of FMS symptoms and the subsequent diagnosis of FMS (see Table 5-1). Other members of the sample reported a variety of extracurricular related trauma: motorcycle accident, falling off a horse, falling down stairs, falling on ice, being hit by a cyclist, and work injury related to lifting. These trauma occurred anywhere from several months to many years prior to the diagnosis of FMS and were reported by 32% of the FMS sample.

When the incidence of physical trauma was examined in the control group, only one person (5%) reported having been involved in an MVA while three subjects (15%) reported having experienced injuries related to extracurricular involvement.

In comparing this with data from other studies, Waylonis and Perkins (1994) found 60.7% of a sample of 176 individuals diagnosed with post-traumatic FMS reported the onset of their symptoms following an MVA. Other subjects in their study noted the onset of symptoms to occur after a work-related injury

(12.5%), after surgery (7.1%) or after a sports-related injury (5.4%).

FMS and Psychosocial Trauma

The historical background of these people contained a variety of stressful events. Sexual abuse (24%), physical abuse (28%), parental alcoholism (36%), and suicide of a parent (12%) were several trauma mentioned in the interview conducted. Twenty-four percent of the sample were raised in single-parent families following divorce of their parents. The death of a parent or sibling was mentioned as being traumatic by 60% of the sample. Perhaps the most extreme example was of one subject who reported being the person who discovered her father after he had committed suicide. In contrast the non-pain control group contained only one person (5%) who had been sexually abused. One subject (5%) reported having been emotionally neglected/abused and only two subjects (10%) reported having experienced a traumatic death in the family.

Boisset-Pioro, Esdaile, and Fitzcharles (1995) found that when compared against a sample of female rheumatology patients (N = 161) a sample of females with FMS (N = 83) demonstrated a significantly higher prevalence of lifetime sexual abuse (17% versus 6%) and physical abuse (18% versus 4%). Taylor, Trotter and Csuka (1995) found similar levels of sexual abuse (65% versus 52%) when comparing women with FMS (N = 40) against a group of women (N = 42) who had no major medical condition or any connective tissue disease. While both studies point to a possible

role of sexual abuse in the etiology of FMS, further research is necessary to determine the nature of that relationship. Differences in the percentage of control group subjects reporting histories of sexual abuse may be related to variations in sampling procedures.

FMS and Current Relationship Status

Sixty percent of the FMS sample from the current study had experienced a divorce/separation in their own life while only one subject in the control group had experienced a separation. Wolfe et al. (1995) indicated that divorced women had a four times greater chance of having FMS than married women. Of the 25 subjects who participated in their study, only 36% were currently in stable marital relationships. In contrast 75% of the control groups were in stable relationships.

When questioned about sexual activity, only 16% of the subjects in the FMS group reported their sexual functioning as being unaffected by FMS symptoms. Twenty percent said that the pain affected their sexual life to a moderate extent while 64% indicated they were not sexually active. However, 60% of the FMS sample was divorced and living alone or with their children. Of the 40% of subjects who were living with a significant other, only 12% reported that their sexual functioning had not been affected by the pain. The remaining 28% reported that sexual involvement, if present, occurred not more frequently than monthly. In comparison 50% of the control sample reported having sexual involvement at least 2-3 times per month. Some (25%) of the

control sample chose not to discuss this area during the interview while the remaining 25% were single and also chose to provide limited information of this topic.

Pain Observations

Fordyce (1976) presents a perspective on pain that focuses on what chronic pain patients have learned about pain from their family of origins and how pain behavior is perpetuated through inadvertent positive reinforcement in their current living situations. In examining the family backgrounds of members of the FMS sample, 60% were reared in families in which physical illness was an important feature during their formative years. Illnesses which extended family members suffered from included brain tumor, arthritis, heart problems, back problems, polio, cancer and back problems to mention but a few. A statement made by one subject appeared to epitomize the position held by Fordyce: "My mother was always sick, very controlling. If something didn't go right, she got pneumonia or bronchitis, which was quite often". Given the amount of psychological trauma which the FMS sample experienced, it is also appropriate to ask what type of coping skills were learned in such dysfunctional learning environments. Comparisons with the non-pain control group were not possible in this section as comprehensive family histories were not collected.

There were many common themes evident when subjects were questioned about their experience of pain. There was general agreement that the pain was everpresent and varied only in intensity, that it moved from place to place in their body, and

that static postures tended to exacerbate the pain. Words and phrases used by these individuals to describe their pain included 'aching', 'throbbing', 'sharp', 'stabbing', and 'burning'. Several individuals referred to the pain as feeling like "somebody is poking inside me". They understood well the description offered by a FMS patient who was not a study participant: "It feels as if someone is driving a steel spike lengthwise through the bones in my legs.". Subjects in this sample experienced their pain in a very similar manner to that reported in the literature. All subjects reported painful stiffness present on awakening in the morning. After performing exercises to ease the stiffness, subjects reported a gradual increase of fatigue and pain as the day wore on. Shortness of breath, feelings of tingling and numbness in extremities, and hot localized sensations became more evident as subjects proceeded with daily tasks. Not only does such activity use up valuable energy which could be applied elsewhere (e.g. work, relationships, leisure activities) but it also establishes a new focus to one's daily activity. Instead of a job being the purpose to a course of daily activity, the FMS subject must first seek some degree of freedom from the pain before they can then move on to other things.

Pain and Social Support

Many subjects (36%) reported feeling a lack of support from relatives, family members, and friends in their experience of pain. Quite possibly this is because of the difficulty for a non-pain individual to understand the type of pain being

experienced. Additionally chronic pain has no overt mark such as is evident with a cast for a broken bone. The overwhelming nature of the experience was described by one subject: "It's so much a part of me I don't know where it begins and ends". With such a perceived lack of support comes an increasing sense of isolation. While friends may initially be willing to offer sympathy to the FMS sufferer, this support quickly dwindles. The burden which such chronic pain places on friends and relatives is recognized by the person with the illness and often times the social withdrawal and isolation which occurs is self-imposed.

Subjects, however, did not appear shut out from therapeutic circles. Rather, the opposite extreme was seen. All subjects had been involved with numerous doctors, specialists, physiotherapists, and other paraprofessionals. A few (28%) were venturing into alternative forms of therapy (e.g., herbal healing, accupressure, massage). However, financial restraints may have served to place a cap on the use of these methods.

Support systems were present for members of the non-pain control group. All subjects were working in situations which had available at least moderate degrees of social interaction and support. Additionally, all by one subject (5%) stated they had supportive relationships with friends and family members. Two subjects (10%) from the control group acknowledged making use of alternative therapy measures, in one instance for stress management and in a second instance for self-growth and education.

Buckelew, Murray, Hewett, Johnson, and Huyser (1995) demonstrated a strong correlation between self-efficacy and self-reporting of pain. As self-efficacy increases, pain perception decreases. Over half of the current FMS sample (52%) stressed the importance of a daily exercise routine to assist them in coping with their pain. Some individuals identified this as a battle, as a refusal to give up or give in to the pain; however, in others, the sense of helplessness and hopelessness evident in their stories made the clinical aspects of the depressive symptomatology present even more worrisome. The themes of isolation, abandonment, control and dependency have been identified (Pollin, 1995) as major concerns in many types of chronic illness. These themes were present in the daily lives of the FMS subjects and constituted an additional layer of pathology with which many subjects struggled. For many of the subjects the combination of distressing early life experiences, serious medical concerns, grave psychological trauma, and the disruption of the normal flow of daily activity because of the chronic pain from FMS leads to a attitude of hopelessness and by a constant struggle to meet basic needs which friends and co-workers take for granted. The need to retain and in some cases regain that control from the chronic pain presented as a major therapeutic task for this group.

Summary

This sample of 25 FMS subjects interviewed presented as being similar on many variables to the samples described elsewhere in the literature (Boissot-Pioro, Esdaile, & Fitzcharles, 1995;

Henriksson et al., 1992; Taylor, Trotter, & Csuka, 1995; Wolfe et al., 1995). Variables on which this sample presented with an increased incidence included sexual and physical abuse as well as incidence of divorce.

When compared to the non-pain control group the list of variables increases considerably. More FMS subjects were divorced/separated, had experienced a greater amount of life stressors (e.g. divorce in their family of origin, physical or sexual abuse, or traumatic family death) and were admitting to different physiological problems (e.g., headaches, Irritable Bowel Syndrome, Diabetes, or Scoliosis) (see Table 5-1). They appeared more isolated from support networks although this may have been due to the manner in which pain affected their ability to socialize and participate in different extracurricular activities.

Despite these differences, almost half of the sample (48%) continued to be gainfully employed, albeit to a modified extent. Many refused to give in to the pain associated with FMS and were aware of having to wage a daily battle against the pain.

In reviewing the life histories of these subjects, there is more than ample indication of overpowering life pressures which affect not only their development of adaptive coping skills but also their establishment of healthy work and personal relationships. Given the amount and nature of the physiological and psychological stressors evident in the life histories of people suffering with FMS, Freud's consideration of pain resulting

from an excessive and unmanageable amount of excitation has relevance. Yunus (1994) has coined the term 'dysfunctional spectrum syndrome' to encompass a variety of conditions (e.g. fibromyalgia, irritable bowel syndrome, headaches, dysmenorrhea, chronic fatigue syndrome) in which there has been a disturbance of normal neurohormonal homeostasis. If it is true that combinations of psychological and physiological stressors can bring about such a disturbance then it becomes all the more important that research into the diagnosis and treatment of these conditions be multidisciplinary in nature and that both quantitative and qualitative methodologies be utilized in unravel the complexities of the processes which underlie them. The value of a comprehensive and exhaustive history can serve not only to enlighten the assessment and treatment process but also to prioritize the important issues which require resolution.

Conclusions and Personal Observations

From the data collected in this study, the FMS sufferers appeared to be representative of the population of FMS sufferers as described in the literature. It would be difficult however to place each subject into one of Masi's (1994) three subclassifications of FMS (primary, concomittant, and induced). While such a classification scheme may serve some useful purpose, it is at odds with the statement that "complex multifactorial mechanisms are believed to operate in the causation of FMS and related functional disorders" (Masi, 1994, p. 989). In examining responses provided regarding types of treatment utilized, it was

obvious that all subjects had used a wide variety of treatment options ranging from the traditional (pharmacotherapy, physiotherapy) through to the more unproven (vitamins and herbs, massage, yoga).

There did appear to be a separation based on the dichotomy of a personal attitude of defeat versus one of being obstinate/stubborn. Subjects in the latter group, while experiencing many of the feelings and attitudes of the former group, continued to cope with daily stressors, interact with friends and colleagues, and live their life as they chose to within the scope of the pain which affected them. Subjects in the former group appeared to have a resigned, hopeless, and helpless attitude which permeated their daily functioning. While both groups of individuals require the support of medical and paramedical professionals, the latter group would fall within the scope of psychological practice. If psychological interventions can help FMS sufferers regain a sense of control, move out of their isolated world, become more independent, and recover and maintain a confident and efficacious self-image, then each individual and society as a whole becomes richer for this improvement. Future research in FMS must address the complex interplay of physiological and psychological factors to answer the many unknowns of this syndrome.

It would also be beneficial if further research into the relationship between FMS and life history variables were to make use of a standardized format and set of questions by which to

collect and describe important pieces of data. One such instrument which offers the potential for such an analysis is the Heimler Scale of Social Functioning (Heimler, 1975). Synthesis of information around the areas of work, finance, friendship, family, personal (positive scales) and activity, somatic, personal, depression and escape routes (negative scales) provides information on problematic areas requiring resolution for a return to psychologically and physically healthy functioning.

My personal observations left me in awe of the brave struggle which many of the subjects were demonstrating and quite saddened by what appeared in other subjects to be an attitude of having given up their lives to the illness. The multidimensionality of the problem was evident throughout and served to strengthen my personal belief in the usefulness of transdisciplinary treatment programs. The need to tailor treatment programs to suit individual situations becomes an undertaking which can be monumental given current economic restraints.

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CHAPTER 6

DISCUSSION AND IMPLICATIONS

The series of exploratory studies conducted in this dissertation were designed to provide clearer guidelines for the use of biofeedback with Fibromyalgia (FMS) sufferers. Currently, psychological interventions with chronic pain conditions, and in particular FMS, are being examined so that clinicians can better determine the role which psychology can play in the diagnostic, supportive, or rehabilitative phase of this chronic illness. While there is still little consensus as to the cause of FMS, there is growing agreement that the illness requires an examination of the physiological and psychological status of the patient (Boissevain & McCain, 1991; Masi, 1994; van Houdenhove, Vasquez, & Neerenckx, 1994; Yunus, 1994).

Findings and Existing Research

In the first study of this project, there were no significant differences in the electromyographic (EMG) activity of three muscle groups that were examined. When EMG readings from an FMS sample were compared against readings taken from a non-pain control sample there was no evidence of dysponetic functioning in the form of elevated EMG activity or bilateral asymmetry. Whatmore and Kohli (1974) view both of these features as indicative of the presence of dysponetic muscle functioning. EMG readings taken bilaterally from the upper trapezius, sternocleidomastoid (SCM), and brachioradialis muscle in a group

of FMS clients and a group of non-pain controls were not significantly different. When EMG activity was examined during a period of relaxation, during a period when each muscle was put to work, and during a period of general work, there were no differences between the two groups. There were, however, significant differences between the two groups on measures of general activity level, outdoor work, and activities away from home as measured by the Multidimensional Pain Inventory (Kerns, Turk & Rudy; 1985).

To date there has been no research which has examined the EMG signal from muscle groups adjacent to or including the tender points characteristic of FMS. Additionally, the existing research has not made reference to the theory of dysponesis put forth by Whatmore and Kohli (1974).

Vitali et al. (1989) obtained EMG data from the thenor prominence (fatty pad in the palm below the thumb) following an ischemic maneuver and interpreted their findings as evidence of neuromuscular hyperexcitability (NMHE) in FMS patients. Jacobsen and Danneskiold-Samsoe (1989) using isokinetic muscle strength, recorded activity from the right knee extensors. Using needle electrodes from the biceps, brachii, trapezius, and tibialis anterior, Zidar, Backman, Bengtsson, and Henriksson (1990) obtained EMG readings. Svebak, Anjia, and Karstad (1993) assessed EMG activity from both active and passive forearms during a

perceptual-motor task. Muscles assessed included the median flexor corpi radialis, neck, and mid-trapezius.

Results from the latter three studies did not support the presence of high muscle tension in FMS. Vitali et al. (1989) did think that their results were supportive of NMHE. Findings from Study 1 of this dissertation demonstrated that the EMG activity in FMS subjects is not significantly different from EMG activity in people in the general population, even when tender point muscles are examined. There is no evidence of dysponesis in the muscles being examined in the present FMS sample.

To examine for the presence of dysponesis from another perspective, a dynamic protocol was introduced into a treatment paradigm to determine if FMS subjects would have difficulty with returning EMG signals to baseline levels once the required activity had ceased. In a second study five women from the FMS group were chosen for a series of EMG biofeedback treatment sessions. Three individuals reported deriving moderate benefit from the treatment and one derived only mild benefit. These benefits were not related to VAS pain readings or to EMG readings. One person derived no benefit from the treatment despite some increase in awareness of different psychosocial and postural changes which interacted with her pain. The benefit and learning obtained for these subjects served to give them more control over the pain in their lives. However, the learning involved appeared to have little to do with returning muscle activity to a resting

baseline. While pain levels fluctuated throughout the treatment period, a sense of self-efficacy was apparent. In those circumstances where there continued to be life stressors which were beyond control, the subjects' degree of suffering and perceived lack of control appeared more evident. The factors which came into play were many and varied: waiting for a Workers Compensation Board appeal; recalling a past trauma; worrying about a possible job lay off; tendonitis in the elbow; and a poor sleep pattern. Level of pain as measured by a Visual Analogue Scale (see Tables 4-1 and 4-2) demonstrated mild decreases in pain intensity in 75% of treatment sessions. Additionally, three of the subjects demonstrated slight elevations in general activity level (see Tables 4-3 and 4-4) while two demonstrated slight drops in general activity level.

The results obtained in Study 2 do not support the hypothesis that dysponetic mechanisms are at the basis for the chronic pain experienced by FMS sufferers. Previous research (Ferraccioli et al. 1989; Large & Lamb, 1983) has focused on using EMG biofeedback for general relaxation purposes. While some success has been achieved in these studies, it is difficult to know what change is actually occurring which might be leading to a decrease in pain. Additionally Large and Lamb reported that subjective pain levels were not, however, reduced and they pointed to the presence of non-specific factors as influencing the perception of pain.

Findings from Study 2 give some support to the hypothesis that EMG biofeedback can have a beneficial effect on providing subjects with some therapeutic benefits but the nature of that interaction is not evident from the present results. It is possible that there is a learned skill which an awareness of the EMG signal can facilitate but the results from the second study do not imply that muscle bracing is the locus of that intervention or that perception of pain changes to any major extent as a result of that skill. Research utilizing more FMS subjects and using different dynamic protocols for different muscles proximal to the tender points characteristic of FMS would lend greater strength to the findings of Study 2.

In examining the role which FMS played in the lives of the FMS group, the historical data supported current theoretical perspectives presented by Yunus (1994). Medical conditions, psychological problems/stressors, dysfunctional behavior patterns, physical trauma, and being raised in early learning environments which were dysfunctional were all in evidence in the histories of the FMS group. The pain connected with the FMS played a central role in the life schema of each FMS subject. Some subjects refused to succumb to the pain and struggled to maintain a sense of control over their life. Others presented via their histories as defeated, isolated individuals who had turned over control of their existence to a variety of other sources. The points at which different therapies might intervene were many and varied.

Findings from an examination of the history of the FMS subjects indicate that therapeutic intervention which allows for a consideration of medical, social, vocational, personal, and spiritual factors is likely to be much more beneficial. The chronic pain, non-restorative sleep pattern, fatigue, and sense of helplessness which are the benchmarks of FMS exist in a complex interplay which requires the combined expertise of different professional disciplines.

Limitations of Study

The assessment phase in Study 1 focused on three bilateral muscle groups in examining for signs of dysponetic functioning. FMS sufferers differ in the number and location of tender points present. Additionally the present research did not examine whether other muscle groups may have demonstrated signs of dysponesis.

While the current project served to address important questions about FMS and the people who are affected by the illness, it does have limitations which must be taken into account before applying the results to other FMS sufferers.

1. Participants in the study were not randomly selected. All were volunteers and 60% were members of a Fibromyalgia Support Group. Differences did exist in this group of volunteers when two subjects said they refused to return to the FMS Support Group after one meeting as they found it too depressing.

2. Participants in the Assessment and Treatment phase of the projects were involved in many varied therapies. Additionally, they were utilizing a variety of medications to assist with sleep, to ease pain, to control inflammation, and to help manage depression and anxiety. The effect of medications and use of concurrent treatment resources are confounding variables in this study.

3. The first two studies focussed on EMG data from peripheral muscles. Given that there was no evidence of dysponetic functioning, it would be valuable to utilize EEG biofeedback to determine if there are differences in EEG activity in FMS patients when compared with non-pain controls. Exploration of central pain processing signals could prove enlightening.

4. While concurrent involvement in other therapies or use of medications pose confounding variables of an external nature, similar variables exist internally. Conditions such as scoliosis, disc problems, or osteoarthritis have an effect on muscle activity. This mechanical issue was not controlled for in this project.

5. The small number of subjects to whom treatment was provided can offer only beginning insights to direct future research. Providing such treatment to a larger number of subjects and possibly for a greater number of sessions might provide further valuable data regarding the usefulness of this form of intervention.

6. As no follow-up has been conducted at this point, it is not possible to say that the learning which appeared to be occurring did in fact take place. A 6-month follow-up study would serve to answer this question.

Suggestions for Future Research

As with many other studies of a clinical nature, the weaknesses of this study are not unique. The use of more subjects, the use of blind protocols to prevent the therapist from unduly influencing results, and the control of important confounding variables are three major issues which must be attended to in future research. The use of a standardized history-taking format (Heimler, 1975) which could provide information about specific areas of a person's background could prove invaluable in guiding therapeutic interventions.

While ethical problems surround the use of a false-biofeedback control, research which included this feature in the research protocol could serve to address the issue of placebo effect. Finally, a better understanding of the differences between FMS subjects who continue to lead normal existences in spite of their symptoms and those who lead helpless, hopeless, isolated lives might serve to uncover new findings which could be applied to those FMS sufferers who have been more resilient to different treatment methodologies.

Given the economic and personal effects which FMS is having, it is imperative that transdisciplinary communication and research

focus and cooperate in research in this area. Multivariate multicentre research can further extend the knowledge base on this condition.

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APPENDICES

Appendix A

Request for Volunteers

Volunteers Needed

Volunteers are needed to assist in a research study. My name is Jim Eliuk. I am a doctoral student in the Department of Educational Psychology at the University of Alberta. I also work part-time at the Glenrose Rehabilitation Hospital. I am conducting research on a chronic pain condition called Fibromyalgia.

I am seeking volunteers for a control group. To qualify you must be female, between 20-60 years of age, and not suffering from any illness which has chronic pain associated with it (e.g., rheumatoid arthritis, low back pain).

If you qualify you would undergo an assessment of muscle activity in specific areas of your body - forehead, neck, upper shoulders, and arms. Information is obtained from sensors which are taped onto the body over the muscle sites. No needles are involved and no pain or discomfort is caused by any of the procedures. The time required for each person is approximately one hour.

If you are willing to participate in this study, please contact Jim Eliuk at 488-8203 to indicate your willingness to help out with the control group.

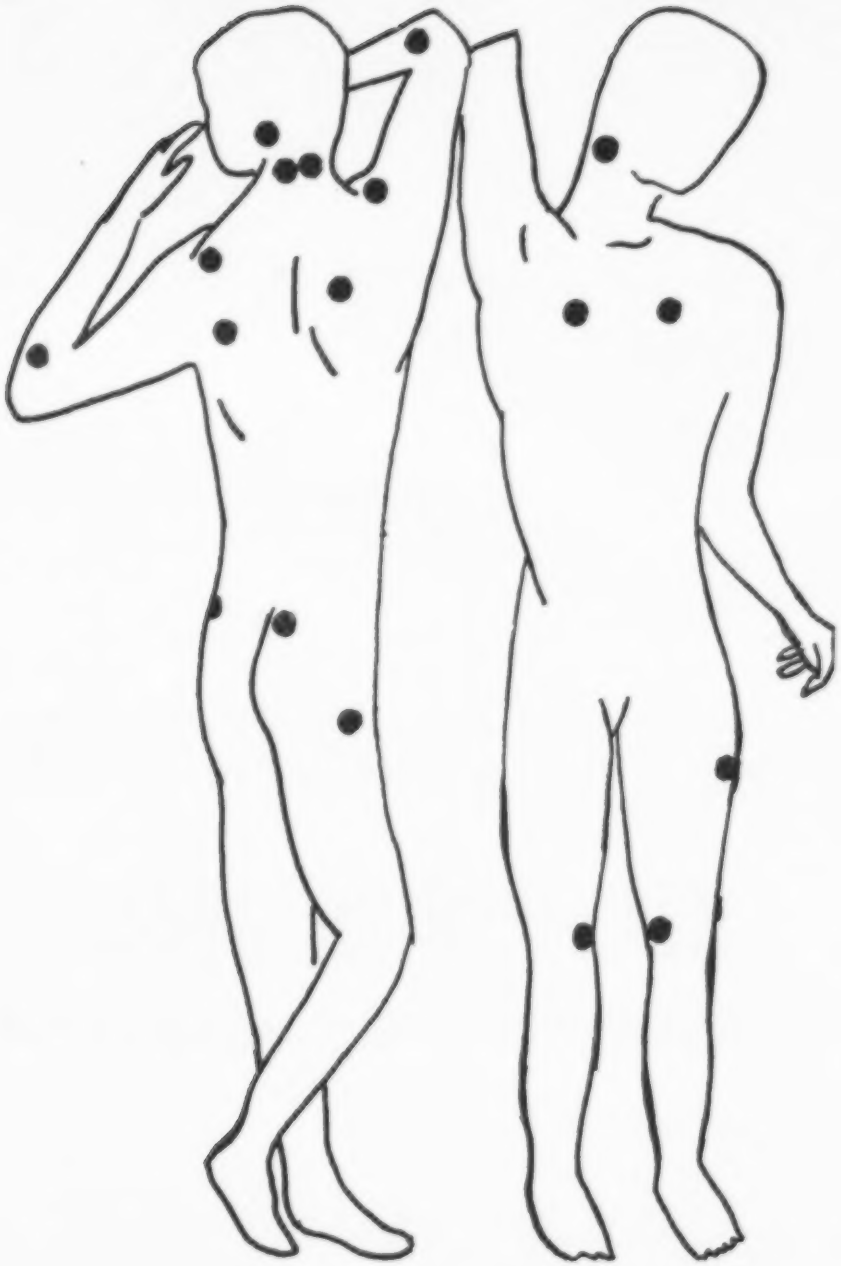
Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group
Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group
Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group
Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group	Jim Eliuk - 488-8203 Control Group

Fibromyalgia Sufferers Can Help
Will You?

My name is Jim Eliuk. I am doctoral student in the Department of Educational Psychology at the University of Alberta and am currently preparing to conduct research examining the manner in which psychologists might contribute to the assessment and treatment of people suffering from Fibromyalgia. Would you be willing to volunteer? I am seeking volunteers who would be willing to undergo a review of history surrounding their illness, undergo an assessment of muscle function using biofeedback technology, and be open to receiving a series of therapeutic sessions aimed at counteracting the effects of Fibromyalgia on day-to-day functioning. This information will be used to inform medical and other health professionals to better define the role of the psychologist in relation to other treatment regimes. If you have been diagnosed with Fibromyalgia, are between 20-60 years of age, and would be willing to participate in this study, please contact Jim Eliuk at 488-8203 to indicate your willingness to help out. Information resulting from this study shall hopefully be summarized sometime in the Fall of 1995 and be made available to the participants and their doctors.

Appendix B

Figures



Adapted from Martin, L. (1994). Fibromyalgia: A real pain. Family Health, 10, 23-24.

Appendix C

Consent to Participate

CONSENT TO PARTICIPATE

Title of Project: Psychological Factors in the Assessment and Treatment of Fibromyalgia

Investigator: Jim Eliuk, M. Ed., C. Psych., Ph. D. Candidate
Department of Educational Psychology
University of Alberta PHONE: 492-5245

The purpose of this research project is to investigate the role which biofeedback has to play in the assessment and treatment of Fibromyalgia (FMS). Double-sided adhesive sensors will be attached over specified muscle groups to assess the amount of muscle activity present. These muscle groups will be near the elbow, on the neck, on the shoulders and on the forehead.

I agree to participate in an assessment which will focus on relevant personal history. I understand that part of the time will involve assessment of the activity in muscle groups in my arms, shoulders, neck, and head. I also agree to answer a brief questionnaire which assesses my ability to undertake a variety of household duties. I understand these prodedures will be done in one session lasting approximately one hour.

The investigation carries no apparent risks to me. All information will be coded so that I cannot be identified. My name will not appear in any documents or reports.

I realize that I may not benefit directly from this investigation which is designed to contribute to a better understanding of the role of the psychologist in the assessment and treatment of fibromyalgia.

I understand that I am free to withdraw my consent and terminate my participation at any time.

I have been given the opportunity to ask whatever questions I desire and all such questions have been answered to my satisfaction.

_____ _____ _____
Signature of Participant Subject Code # Date

_____ _____
Signature of Witness Relationship of Witness to Participant

Appendix D

History Questionnaire

History Questionnaire

A. History of FMS, Time of Diagnosis, Precipitants

FMS	antecedents	exacerbators	ameliorators
accident/injury			
litigation			
medical illness			
major life change (divorce, death of family member)			
pain treatment			

1. PAIN: when does it occur,
changes in intensity, fluctuations through day,
location, areas of referred pain

2. SYMPTOMS ACCOMPANYING PAIN

vomiting	numbness/tingling
nausea	heart beating fast
dizziness	heart beating loud
feeling faint	noise sensitivity
fear	light
rapid breathing	irritability
sweating	palpitations
blurred vision	anxiety
visual prodroma	depression
other	

HISTORY QUESTIONNAIRE 2.

3. CURRENT PAIN antecedents exacerbators ameliorators

worry
tension
physical exercise/movement
menstrual cycle
relaxation
weekends
vacation
concentration
reading
studying
listening to talks
noises
excitement
quarrels
anger
emotional times
sunshine
hot baths
precision work
sex
annoyances
diet
alcohol
fatigue
weather
sympathy and attention
cold/heat
accidents/injury
litigation
medical illness

4. MEDICAL HISTORY

Illnesses (childhood, genetically related, toxically related, infections), outcomes, surgeries, outcomes, hospitalizations, outcomes, past medication regimes.

HISTORY QUESTIONNAIRE 3.

B. Personal History

1. GENOGRAM - family of origin
childhood experiences, memories, trauma; memories of upbringing; relationships in family, discipline, important scripts, memories of health-related issues in family of origin, management of sick behavior, educational background, hobbies, interests, social relationships, behavioral/legal/psychological issues.

2. GENOGRAM - current family, history of dating behavior, marriage, current family dynamics, current family stressors (emotional, financial, psychosocial), perception of support/lack of support from family members (encourage/support, ignore/become angry, distract, encourage activity despite pain, encourage to avoid); medical health of other family members.

HISTORY QUESTIONNAIRE 4.

3. WORK HISTORY - type of jobs, length of stay, job-related problems; future orientation, motivators to return, (money, enjoyment, other)

4. DAILY HABITS - smoking, coffee, alcohol, illegal drugs, birth control pills; eating/sleeping behavior sexual relationship, current physical activity, leisure/social activities.

HISTORY QUESTIONNAIRE 5.

C. Current Treatment

1.

	name	time on dose	helpful or not
medications			
physiotherapy			
acupuncture			
aerobics			
biofeedback			
relaxation techniques			
psychotherapy			
pain management programs			
nerve blocks			
massage			
herbal healing			
support groups			

2. Effects of past/current treatment on self-concept, self-esteem, on thinking patterns, coping skills, behavior patterns.

3. Current sources of support (internal/external)

4. Describe a typical day.

D. Behavioral Observations

complains of pain_____; grasps area of pain_____;
grasps other areas_____; moans_____; cringes_____;
winces_____; gets up to pace, stretch_____; leaves room_____; frequently
changes position_____; becomes angry_____; becomes anxious_____; becomes
tearful_____; verbal and open_____; sparse verbal content_____; good eye
contact_____

E. Current Involvement

dusting_____; vacuuming_____; dishwashing_____; shopping_____; cooking_____;
clothes washing_____; clothes ironing_____; errands _____; repair work _____;
yard/garden work_____; bill paying_____

F. Current Financial Income

UIC
Pension
Disability
Social Assistant
AISH
Savings
Is litigation pending in regard to your pain problem?

Appendix E

Histories for Subjects A, C, E, G, and M

Subject 1

Subject A is a 43-year old married mother of two. She was diagnosed with Fibromyalgia in 1993 and felt it was related to a work-related injury she suffered while lifting a patient in 1990. Following eight months in rehabilitation and retraining, she returned to a clerical position on a part-time basis. She reported that osteoarthritis and degenerative disc disease were diagnosed after her accident in 1990. Additional stressors which have been present over recent years include the death of her father-in-law and the conflict associated with the will. Her husband was also experiencing a significant amount of work-related stress and has a history of manic-depressive illness. Medically, A reported that she is bothered by Premenstral syndrome and that she has bowel related difficulties although IBS has never been medically diagnosed. She does have migraine headaches and visual prodroma associated with onset of the headache.

A is the youngest of two girls and one boy. Her mother died when A was two years old and following a remarriage to a lady who did not know how to raise children, she reported that her father became a "closet alcoholic". She said that school work was always difficult for her and she failed Grades 3 and 8. She said that she was born three months premature. Socially she had few friends and after leaving home at the age of 17, began working as a housekeeping aide. She later returned for educational upgrading and at the time of her 1990 accident was working as a Nurses Aide.

She described her pain as affecting her neck, shoulders, and back. In describing the pain she said that while it is everpresent, it is worse on awakening and when she becomes tired. Associated with the pain is a sense of fear and irritability, numbness in her hands, light and noise sensitivity, and feelings of anxiety and depression. Her pain can be alleviated with warmth, hot baths, the use of a transcutaneous electrical nerve stimulation, and medications. She tries to maintain a daily exercise routine consisting of walking and stretching exercises. Eating habits are good, however, her sleeping pattern is rather inconsistent. She will sleep well for several days then will have several nights during which she obtains very little restorative sleep. She said her husband has told her that she moans and groans in her sleep. At the time of the original contact, A was taking Adalat and Tylenol 3 on a regular basis. When the treatment phase was started, she was also taking Imipramine, 150 mg daily. Just prior to the last of the twelve treatment sessions, she was taken off Tylenol 3 and placed on Voltaren, Norflex and Atavan.

When bilateral EMG readings taken from the upper trapezius, sternocleidomastoid, and brachioradialis were compared against those from the non-pain sample in Study One, Subject A had readings more than two standard deviations greater than the mean on bilateral readings from the upper trapezius and SCM as well as the left brachioradialis during the static phase, from the upper trapezius (bilaterally) and left SCM during the dynamic phase, and

from the upper trapezius (bilaterally) and right brachioradialis during the work phase.

Subject 2

C is a 40-year old married mother of three boys. She was diagnosed with FMS in 1989, after her second child was born. She reported that after her last pregnancy, the pain she experienced was so intense that she was off work for a year and that she would drag her left leg behind her because of the pain. A myelogram and CT scan demonstrated the presence of degenerative discs in the lumbar region of her spine. Currently she is experiencing some stress from her husband's limited awareness and understanding of her pain and from having to handle many of the child management issues herself. Medically, C said that she fell down a flight of stairs when she was 19 years old and this resulted in a herniated disc. She did not have back surgery, rather received 3 1/2 months rehabilitation, including a course of Valium. She has had asthma in the past and does have a heart murmur. She had a submucus resection when she was 22 years; she had a bowel fissure repair when she was 25 years; and she has suffered a knee injury and an achilles tendon injury, both sports related. Finally she had a therapeutic abortion when she was 17 years, had two miscarriages between her first and second children, and suffered a post-partum depression after her last child. While she reported difficulties with constipation, she has never been diagnosed with IBS.

C is the youngest of two girls and one boy from an intact family. She has a fraternal twin brother. A sister five years older, has also been diagnosed with FMS and lupus. She described being raised in a dysfunctional family and being physically abused

by her alcoholic mother. Her father had undergone spinal fusion and is deaf from a war wound. She said that she watched her mother try to kill her father three times. After leaving home she worked in a variety of jobs and eventually became a Registered Nurse.

She described the pain she experiences as being bilateral in nature, primarily in her arms, neck, shoulders lower back and through her left leg and thigh. In describing the pain she experiences she said it is quite sharp, at times feels like a tugging in the muscle and is worst in the morning in her lower back. She said it is always there and only the intensity varies. Accompanying the pain are a heightened sensitivity to light and noise, excessive perspiration, and feelings of dizziness. The pain can be alleviated with hot baths, sunshine, periods of relaxation, acupuncture, Tylenol 3 and Flexeril. Increases in pain intensity are preceded by her monthly menstrual cycle and the pain is exacerbated by tension, quarrels, moderate levels of exercise, fatigue, and cold weather. She has attended Weight Watchers to establish regular eating habits. As well she gained an excessive amount of weight after being placed on Elavil. Her sleeping pattern continues to be quite poor. At the time of original contact, C was on Flexeril, Voltaren and Idarac. When the treatment phase began, C had been involved in a motor vehicle accident some five months previously. She suffered injury to her neck, shoulders, arms and temporomandibular joints. She had been prescribed Stemetil, Flexeril, Zoloft, Imovane and Depomedrol

injections for right elbow tendonitis. At the time of the treatment phase of the study, C was continuing to use Zoloft. She denied using alcohol and said she smokes half a pack of cigarettes a day.

When bilateral EMG readings taken from the upper trapezius, SCM, and brachioradialis were compared against those from a non-pain sample, Subject C had readings more than two standard deviations greater than the mean on bilateral readings from the SCM during the static phase as well as from the left SCM muscle during the dynamic phase.

Subject 3

Subject E is a 34 year old single lady who was diagnosed with FMS in 1994. She had been diagnosed with IBS in 1993 and said that the symptoms associated with IBS coincided with several psychosocial stressors during the previous year. Her boyfriend's mother was in hospital for 6 weeks before dying and E became quite tired from having to spend a great deal of time at the hospital. A cousin to whom she was quite close also died later the same month. She was in a common-law relationship for five years. While she now lives separate she still dates her boyfriend who has been in ongoing divorce proceedings.

E is the only child from parents who divorced when she was 15 years old. She recalls being raised in a dysfunctional family and a tension filled household. She described her father as "getting on with his life" while her mother had to stay at home with a sick child.

After completing high school, E took two years of post-secondary study in accounting. She took additional training in computers and has been in her current position for 8 years. Much of her work has involved bookkeeping, computers, and accounting.

E described the FMS as affecting her arms, shoulders, and neck, primarily on the right side. Occasionally her thighs and legs will experience pain. The pain is at its worst when she awakens in the morning and in the evening after a busy day. She recognizes that stress contributes significantly to her level of

pain and also recognizes the effect which a poor sleeping pattern has on the intensity of pain.

Medically she described an early development marked with illness because of an undiagnosed milk allergy. She is asthmatic but controls it with antihistamines. She had knee surgery at age 16 years as her kneecaps and shins were not in alignment. She had been prescribed medications for high blood pressure in the past and felt this was related to anxious feelings she experienced when no one was able to diagnose her pain concerns.

In describing the pain she experiences from FMS, she reported that cold, fatigue, anger, tension, and static postures tend to exacerbate the pain while warmth, periods of relaxation, reading, and vacations tend to decrease her perception of pain. The pain may be accompanied by rapid breathing, increased heart rate, numbness/tingling from her fingers down through her body, and increased irritability. She admitted to having experienced periods of depression brought on by the pain. Regarding daily habits she denied using alcohol or cigarettes, reports having two cups of coffee daily, and has regular meals. She avoids spicy and fried foods because of her IBS. While the pain can be a factor in the area of sexual functioning, she denied that it has been a major concern. Her pain can affect her sleep cycle but she reported having restful sleep about half of the time. Walking and stretching exercises keep the pain in her legs, arms, and shoulders from getting out of control. Currently she is on birth

control pills, Tylenol 3, Modulon, and various vitamin supplements.

When bilateral EMG readings taken from the upper trapezius, SCM, and brachioradialis were compared against those from a non-pain sample, Subject E had no readings which were greater than two standard deviations greater than the mean of the non-pain sample.

Subject 4

Subject G is a 48-year old divorced mother of three children. She was diagnosed with Fibromyalgia in 1994. She has a history of being involved in two motor vehicle accidents in the years prior to the diagnosis of FMS and said that while she did not sustain any injury in either accident, she felt a terrific shock to her system from the possibility that the MVA may have been fatal. She went through a divorce in 1986 and experienced considerable financial stress after the company for which she had been working was involved in a bank fraud and her husband declared bankruptcy causing more financial debt for her. Medically she described an 18-year history of difficulties with leg cramps which have gradually subsided. She also suffered from post-partum depression after the birth of her second daughter. When questioned, she said that she has had Irritable Bowel Syndrome (IBS) for the past few years.

She is the second eldest of two girls and three boys from a Welsh family. She described herself as being very shy as a child and as experiencing much anxiety around exams. Her own marriage was to a professional who developed an alcohol problem and had begun threatening to leave her three years into the marriage, just after their son was born. She said she was made to feel very insecure by her ex-husband. At the time of bankruptcy she was working in the secretarial area.

She described the pain from FMS as being bilateral in nature and affecting primarily her shoulders, back, arms, and legs. The

pain is everpresent, cramping in nature, "like an internal muscle tension", and is generally worse in the morning. Features which accompany the pain include feelings of numbness/tingling, nausea, blurred vision, increased irritability, and sensitivity to noise and light. The pain is made worse by cold, fatigue, psychosocial stressors, quarrels, periods of concentration and reading, and worrying. She is able to alleviate the pain with exercise, relaxation, and hot baths.

Regarding daily habits, she reported very little intake of coffee but did acknowledge smoking about one-half pack of cigarettes a day. She tries to walk about 2 km a day. She described her eating habits as being rather poor over the last several years. Her sleep habits have improved as a result of medications. She is taking Desyrel, Synthroid tabs, and Serzone. In the past she had obtained little help from physiotherapy or aerobic exercises but she did derive some benefit from massage and Cortisone injections to her shoulders.

When bilateral EMG readings taken from the upper trapezius, sternocleidomastoid, and brachioradialis were compared against those from the non-pain sample in Study One, Subject G had readings more than two standard deviations greater than the mean on bilateral readings from the upper trapezius in the static phase, and from the left trapezius in the dynamic and work phase.

Subject 5

Subject M is a 56 year old divorced mother of two boys. She was diagnosed with FMS in 1993. She related the FMS to work-related job stress during a period when she had been extensively involved in keyboarding and had worked much overtime. She reported having had two laminectomies dating back to 1984 to correct acute protruding discs at L4-5 level. She had a cholcystectomy in 1979, kidney stones removal in 1985, and a hysterectomy in 1981 after hemorrhaging after the birth of her only son.

She is the second youngest of four boys and four girls from an intact family. She has one deceased brother whom she said had ulcerative colitis. Her formative years in her family were happy and she described her family as close. She was socially active as a child and teenager. She was married on two occasions, each one lasting 10 years, both to men who had problems with alcohol and fidelity. She has worked in supervisory settings in administrative/payroll situations.

She said the pain she experiences from FMS affects her neck, right shoulder, arm, and biceps. She described the pain as steady, agonizing, sharp, and annoying. At times it feels as if someone is poking inside the painful areas. She had also been diagnosed with IBS and TMJ in 1993 although she thought she may have had IBS since 1984. She described getting "explosions" in her head when she lies down but denied being bothered by migraines.

The pain may be accompanied by dizziness, noise and light sensitivity, palpitations, and anxiety. It is exacerbated by tension, anger, fatigue, and concentration. She has been able to obtain some relief from the pain with hot baths, reading, physical exercise/movement, and periods of relaxation. She also received considerable assistance in coping with and accepting the change in her lifestyle by involvement in a transdisciplinary pain treatment program. Physiotherapy has also been helpful. She has also been actively involved in an FMS support group. Currently she is working four hours a day; she receives a salary supplement from Workers Compensation which has kept her file open since her back surgery.

Regarding daily habits she smokes a pack of cigarettes a day, drinks two to three cups of coffee daily, and now takes an ounce of brandy to help her fall asleep each night. She reported that Elavil had made her more alert at night. She had also received limited assistance from Prozac. She has received cortisone shots as well as dry needling to help control the pain she was experiencing. She sleeps about six hours per night and has used relaxation to foster good sleep habits. She did use the Crohn's diet in the past but currently does not use a diet.

When bilateral EMG readings taken from the upper trapezius, SCM and brachioradialis were compared against those taken from a non-pain sample, Subject M had readings more than two standard deviations greater than the mean on bilateral readings from the upper trapezius and the right brachioradialis in the static phase.